Canadian Industry Program for Energy Conservation

1989

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Errata

Subsequent to publication of the 1989 CIPEC Annual Report, it was discovered that some errors had been made under the Chemical Industry Section. In order to correct the errors, please amend as follows:

page 12. CCPA represents 90 percent of the total chemical industry (not 80 percent as shown).

page 12. In the second paragraph of 1989 performance, the usual increase is 2.7 percent per year (not 2.2 percent as shown).

page 13. In the paragraph beginning "The chemical industry ...", energy costs including feedstocks can amount to 70 percent of total manufacturing expenses.

page 14. Table II. The current year energy consumption is 388,383 terajoules (not 388.383 terajoules). The 1985 Base Year Equivalent energy is 427,748 terajoules. Adjustments amount to 930 terajoules. Performance from 1973 to 1989 has improved 39.4 percent.

CANADIAN
INDUSTRY PROGRAM
FOR ENERGY CONSERVATION

PROGRAMME CANADIEN
D'ÉCONOMIE D'ÉNERGIE
INDUSTRIELLE

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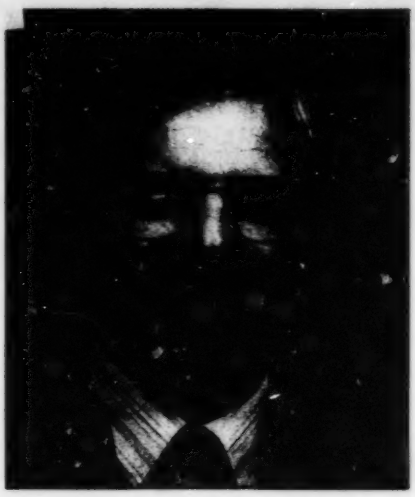

October 31, 1990

The Honourable Jake Epp, P.C.,M.P.
Minister of Energy, Mines and Resources
House of Commons
Ottawa, Ontario
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Dear Minister,

The 1989 energy performance of CIPEC reporting companies reflects the 1985-1989 "energy environment" of soft prices, unfocused energy management effort and an emphasis on other business issues. It does not reflect energy price fluctuations resulting from the current Middle East situation. Nor does it reflect the growing recognition by industry that more effective energy use is a necessary component of the effort required to protect the environment.

Industry's energy use per unit of output for 1989 remained at the same level as 1988 – 28.8% less than the base year of 1973 and 4.8% less than 1985. Given the current economic and business climate, it will be a great challenge to achieve our 1990 goal established five years ago of a 31% improvement over 1973 energy intensity levels.

We are now at the point where new industrial energy reduction targets must be established. The pace of industrial globalization, the restructuring of our economy and its relative competitiveness, the impact of provincial and local utility efforts at energy conservation, coupled with the environmental imperative, will all have to be factored into this target setting process. The Energy, Mines and Resources discussion paper "Energy Use and Atmospheric Change" tables several proposals, including the formation of a Minister's National Advisory Council, that will help address this issue.

These targets and their achievement will provide the industrial sector contribution to the environmental objectives as they did for the energy efficiency objectives of the 1970's and 1980's.

As the CIPEC program begins a new decade, it is imperative that both industry and government reassess their commitment to this effort and work together to establish and move forward with initiatives which will stand the test of the 1990's.The CIPEC council looks forward to participating in this building process.

Sincerely,

W Peter Torbet

W.P. Torbet
Chairman, CIPEC Council

The Canadian Industry Program for Energy Conservation (CIPEC) is an industry-administered/government-sponsored program for promoting and monitoring energy efficiency throughout the Canadian manufacturing and mining industries.

CIPEC was established on May 23, 1975, as a result of deliberations between the Federal Government Ministers of Energy, Mines and Resources and Trade and Commerce, and 50 of industry's most senior representatives. It now consists of 14 different industrial task forces that represent a broad spectrum of Canadian manufacturing and mining industries.

The program's objectives in promoting energy conservation are to:

- Promote energy productivity improvement in Canadian industry;
- Maintain an effective forum for industry/government dialogue on energy utilization and productivity matters;
- Forecast aggregate energy productivity improvement based on Canadian industry programs;
- Collect data and report on energy productivity of Canadian industry.

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Direction of Energy Conservation

1989 PERFORMANCE

Industry's energy use efficiency, covering 72% of the total consumption in the manufacturing and mining sectors, remained at the same level as 1988.

Overall performance has improved 28.8% relative to the consolidated 1973 reference year values, but only 4.8% since the updated 1985 base year levels.

This performance is the result of an annual survey of 629 participating companies in 14 different industrial sectors. CIPEC energy-use efficiency is measured by consolidating the changes in each company's energy intensity levels (energy-use per unit of production).

The individual performance of the participating industry task forces is displayed in Figure 2 together with their respective 1990 performance goals.

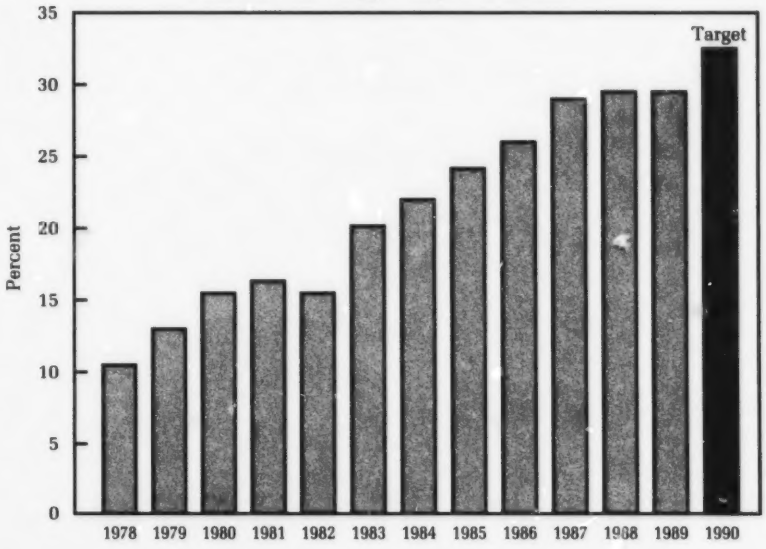
The flat performance is the result of slowing production output, lower capacity utilizations, less than adequate investment in energy improving retrofits, and a focus on other business issues.

Energy Consumption and Trends

Reporting companies used 1,616 petajoules (PJ) of energy in 1989, which was about 72% of the total 2,154 PJ used by all industry. CIPEC energy consumption is equivalent to nearly 267 million barrels of crude oil. By comparison, a city the size of Toronto uses one PJ of energy for all purposes including heating, lighting, transportation, etc., every 15 hours.

Figure 1

CIPEC Energy Improvement



The total Canadian net domestic use amounted to about 7,673 PJ, of which industry used 25.8%, transportation 23.5%, residential and farms 21%, and government and commercial users 13%. Producers and transporters of energy used 920 PJ of energy themselves.

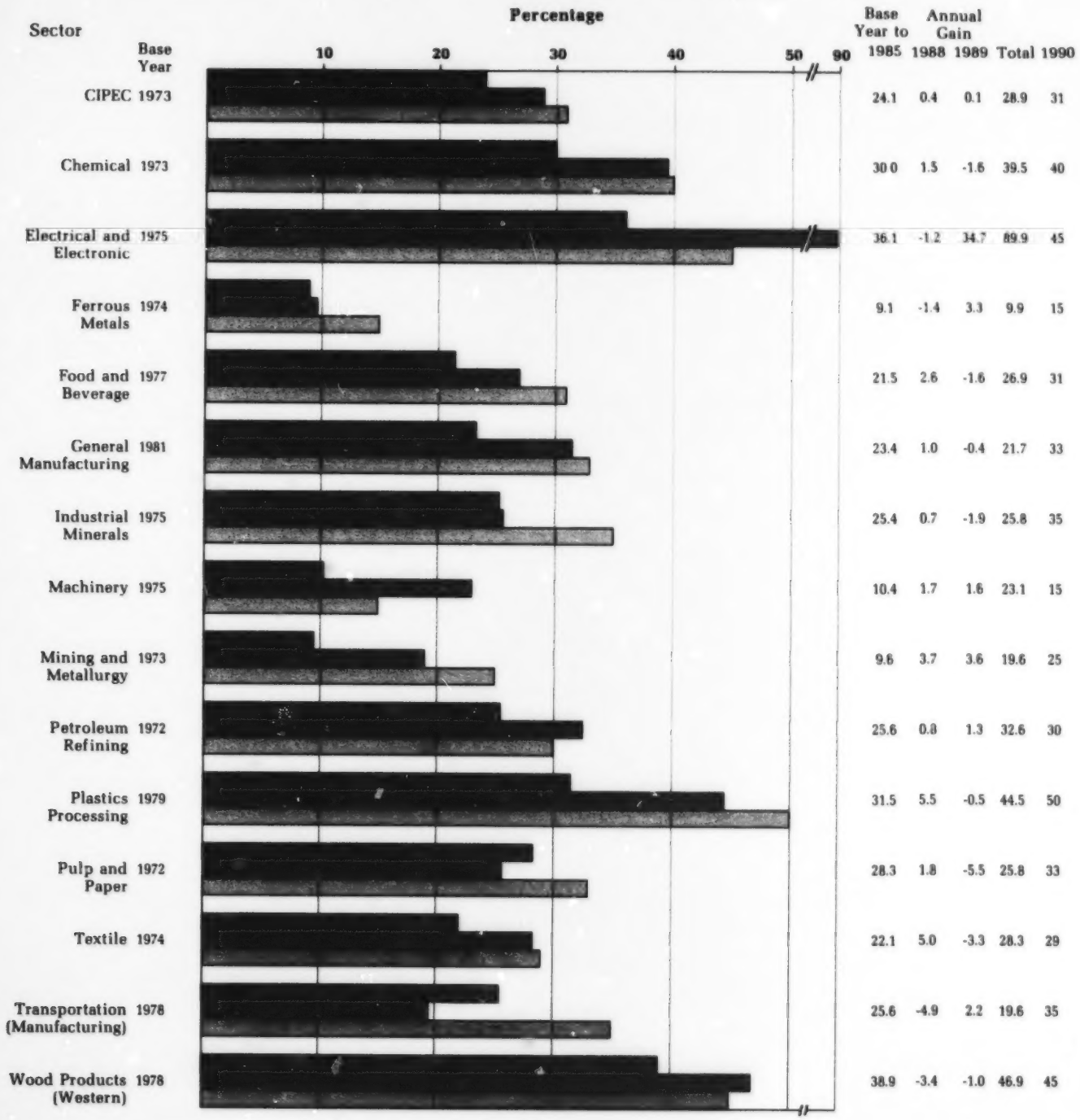
Electricity

CIPEC participants' demand for electricity in 1989 was 9,432 MW. Canada's total net generating capacity was approximately 98,000 MW during the year.

Demand for electricity in the surveyed companies continues to grow by about 1.6% per year because of the continuing trend in automation, greater use of electrical heating, etc. It is estimated that electricity provides 18.4% of the total power, but accounts for 50.7% of the total expense. For all of domestic industry the electricity share is 23.1%, which reflects a broader mix of smaller and more diversified operations.

Figure 2

ENERGY INTENSITY IMPROVEMENT


Sector
Base Year
Percentage
10
20
30
40
50
90
Base Year to 1985
Annual Gain 1988
Annual Gain 1989
Total
1990
CIPEC 1973 24.1 0.4 0.1 28.9 31
Chemical 1973 30.0 1.5 -1.6 39.5 40
Electrical and Electronic 1975 36.1 -1.2 34.7 89.9 45
Ferrous Metals 1974 9.1 -1.4 3.3 9.9 15
Food and Beverage 1977 21.5 2.6 -1.6 26.9 31
General Manufacturing 1981 23.4 1.0 -0.4 21.7 33
Industrial Minerals 1975 25.4 0.7 -1.9 25.8 35
Machinery 1975 10.4 1.7 1.6 23.1 15
Mining and Metallurgy 1973 9.6 3.7 3.6 19.6 25
Petroleum Refining 1972 25.6 0.8 1.3 32.6 30
Plastics Processing 1979 31.5 5.5 -0.5 44.5 50
Pulp and Paper 1972 28.3 1.8 -5.5 25.8 33
Textile 1974 22.1 5.0 -3.3 28.3 29
Transportation (Manufacturing) 1978 25.6 -4.9 2.2 19.6 35
Wood Products (Western) 1978 38.9 -3.4 -1.0 46.9 45

Legend: – 1985 Total Improvement
– 1989 Total Improvement
– 1990 Goal

Source: CIPEC Task Force Reports

In Quebec companies, especially in the pulp and paper industry, there was a noticeable shift away from electricity because of the directed shutdown of electric powered steam boilers.

Natural Gas

Approximately 15.1 billion cubic metres of natural gas was used for process heating, steam generation, HVAC, and other purposes such as feedstocks in 1989. The CIPEC efficiency monitoring accounts only for non-feedstock use. Total domestic consumption of gas amounted to 59.8 billion cubic metres and 37.9 billion cubic metres was exported, according to National Energy Board (NEB) statistics.

The natural gas share, now at 34.8% in the CIPEC surveyed companies, has also gradually increased at about 1.6% per year. This is somewhat higher than the 30.6% overall industrial use because of the difference in the reporting population. For the CIPEC group, it is estimated the gas cost $2 billion, which amounted to about 27.3% of the total energy expense.

As a result of the deregulation following the 1985 Agreement on Natural Gas Markets and Prices, it is estimated that about 25% of national sales are now direct from the producer to the end-user (no direct sales are permitted to commercial or residential users consuming less than 35,000 gigajoules per year at one location).

Petroleum Products

A total of 4.836 million cubic metres (30.4 million barrels) of light and heavy fuel oil and diesel fuel were used by the surveyed companies in 1989. In addition, 418,335 cubic metres of gasoline, propane and LPGs were consumed. Crude oil production in Canada (including conventional light and heavy crude oil, pentanes plus and synthetic crude oil) averaged approximately 265,000 cubic metres per day. At this rate, CIPEC recorded use amounts to only 18 days of total production.

The NEB's estimate of remaining established reserves of conventional crude oil, as of December 31, 1988, is 666.2 million cubic metres, or about 7 years' supply at the current rate of consumption.

CIPEC participants' share of total energy use has dropped from 32% in 1975 to 13% in 1989. Residual oil is still a major fuel component in the pulp and paper and textile industries in the province of Quebec. The combined cost is estimated at some $800 million for fuel oil, gasoline, diesel and LPGs.

Table I

Distribution of Energy Consumption (percentage)

	Electricity [1]			Natural Gas			Liquid Pet. Prod.			Coal & Coke			Others [2]		
	'89	'85	'75	'89	'85	'75	'89	'85	'75	'89	'85	'75	'89	'85	'75
Chemicals	11.2	27.9	17.3	62.3	51.2	57.1	5.6	4.3	24.3	0.4	0.1	—	18.1	16.5	1.3
Electrical & Elect.	35.1	33.5	27.8	54.6	63.6	48.0	8.5	1.4	24.4	—	—	—	—	1.5	0.2
Ferrous Metals	6.8	7.3	5.4	17.0	19.4	15.4	7.9	4.2	13.2	68.3	69.1	68.6	—	—	0.3
Food & Beverage	21.9	18.6	12.8	63.6	69.7	48.5	14.2	11.7	38.5	—	—	—	—	—	0.2
General Mfg.	33.7	28.1	n/a	50.8	60.2	n/a	9.1	11.6	n/a	—	—	—	6.2	0.1	n/a
Industrial Minerals	18.8	15.6	10.3	38.7	42.6	50.6	7.1	8.7	33.1	34.5	32.4	5.8	0.9	0.7	0.1
Machinery	33.9	37.4	23.6	62.5	54.1	22.1	3.4	8.5	51.4	—	—	—	0.1	—	—
Mining & Metallurgy	25.8	41.2	35.1	33.2	25.2	12.4	13.2	23.5	48.0	7.5	9.9	4.4	—	0.2	—
Petroleum Refining	5.3	4.6	3.5	15.8	24.3	12.5	9.0	6.7	22.9	21.6	19.6	16.7	48.1	44.7	44.4
Plastics Processing	46.1	43.2	23.7	47.2	51.4	43.5	4.9	5.4	31.9	—	—	—	—	—	—
Pulp & Paper	36.7	44.9	24.9	29.5	26.1	18.3	31.7	25.8	52.7	1.2	2.9	3.6	0.9	0.3	0.3
Textiles	27.1	29.1	20.1	61.7	55.0	29.1	11.3	15.8	49.9	—	—	—	0.2	0.1	0.9
Transportation (Mfg.)	28.2	30.1	23.0	60.4	55.2	42.1	—	3.7	31.0	7.4	11.0	3.1	0.2	0.6	0.4
Wood Products	54.2	48.0	n/a	45.8	52.0	n/a	—	—	n/a	—	—	—	—	—	—
Totals	18.4	19.1	14.6	34.8	32.3	27.9	13.1	17.6	32.0	18.3	19.2	17.8	12.6	11.8	7.7

Footnotes:

(1) All sectors' electricity converted at 3,600 kiloJoules/kWh.

(2) Other fuels include purchased steam, plant wastes, process by-products, miscellaneous fuels, but excludes wood wastes used in the Pulp and Paper and Wood Products sectors.

Source: CIPEC task force reports.

Coal and Coke

About 9.2 million tonnes of coal and coke were used in CIPEC companies during 1989. Domestic demand for coal increased by 8.5%, from 50.1 megatonnes to 54.4 megatonnes, due again to higher rates of thermal electricity generation; hydro generation is suffering from low precipitation rates and low reservoir levels.

Coal is used primarily in Ontario by utilities and in the steel and cement manufacturing industries. The cement manufacturing sector continues to use large quantities of coal, but has in some instances switched to lower priced natural gas. The largest cement manufacturer is continuing its investigation into cheaper sources such as municipal refuse.

Lime injection scrubbing systems, slagging combustors, irradiation cleanup methods and fluidized bed combustion systems are all technologies which can contribute to lower sulphur dioxide emissions in coal-burning processes. Unfortunately, these environmental safeguards often result in increased energy consumption which impact on the economics of retrofit projects.

Other Fuels

The "other" category includes a diverse mix of wastes, process by-products and miscellaneous fuels used mainly by the chemical and petroleum refining industries. The significant amount of hog-fuel and pulping liquor used in the pulp and paper industry, as well as large quantities of hog-fuel used in the wood products industry, are not included in this category because of the difficulty in measuring heat content and quantities.

Occasionally the use of these "wastes" changes when their resale value exceeds their replacement fuel value. A recent example is the increased sale of by-product hydrogen.

Since many of these fuels are generally free sources of energy, industry has fully utilized this option. Constraints on greater use of waste fuels are the availability of steady supplies and technological problems associated with materials handling and combustion.

1989 Business Conditions

Some key business indicators fundamentally affecting energy utilization are shown in Table II. While GDP rose in 10 sectors and dropped in 4, the momentum for spending on new equipment was mixed, but capacity utilization slipped in 8 industries while gaining in only 6. Usually there is more consistency in these energy-use efficiency related trends.

Another signal of changing business conditions was the growing number of companies that participated in previous CIPEC surveys but now only import products for resale. This is happening more frequently with multi-national low-energy intensive, high-wage operations. In a few instances the disruptions caused by mergers and acquisitions also prevented routine reporting this year.

Capital Investments

Statistics Canada estimates that only 1% of all annual capital investment

[1] Analysis of the Categories of Capital Investment, J. Lacroix, Nov. 1989

Table II **Key Sectoral Business Factors**

Sector	GDP $, MM	GDP Chg.	Capacity %	Capacity Chg.	Investment $, MM	Investment Chg.
Chemicals	7,732	0.7	92.5	0.1	2,258	20.8
Electrical & Electronic	15,275	10.0	99.9	2.4	780	– 1.6
Ferrous Metals	8,766	– 1.1	90.6	– 4.4	3,951	20.4
Food & Beverages	10,218	1.1	77.4	– 1.6	2,110	7.9
Industrial Minerals	3,293	0.7	71.7	2.1	822	5.6
Machinery	3,293	0.7	68.4	– 8.7	572	6.1
Mining & Metallurgy	11,651	—	69.3	– 3.4	4,504	– 4.3
Petroleum Refining	1,165	3.0	76.1	2.0	1,272	18.8
Plastics Processing	1,946	—	79.7	– 7.2	n/a	—
Paper Industries	9,323	—	84.8	– 3.8	7,005	29.1
Textiles	2,951	—	91.1	– 6.2	383	– 14.8
Transportation (Manufacturing)	13,664	– 1.3	64.8	– 7.0	3,206	– 11.0
Wood Products (Western)	3,953	– 1.3	80.7	– 5.9	1,053	– 13.0
Durable Goods	62,095	2.6	79.0	– 3.1	—	—
Non-Durable Goods	46,391	1.0	81.8	– 1.7	—	—
Total Manufacturing	110,574	1.9	80.3	– 2.4	28,463	10.9

in Canadian industry is spent to reduce energy costs. In a survey[1] of spending patterns between 1985 and 1987, about 53% was directed into capacity expansion, 40% for equipment replacement and modernization, 1% for pollution abatement and control, 1% for improvement in working conditions and 4% for other reasons. However, some of the 40% spending on modernization would certainly augment the 1% specifically identified for energy retrofits.

Weather

Industry's energy-use has also been affected by the weather, which has changed significantly over the past decade. Although annual conditions have varied considerably, average temperatures were generally warmer and most of Canada had less snowfall. This evidence comes as we close the decade during which the "greenhouse effect" became a household word. The greatest departure from normal occurred in the Prairies, with up to a 1.4 C° increase above usual conditions. The Maritimes are the only area with slightly cooler temperatures.

The effects of temperature increases have also been significant in other ways. In addition to more frequent forest fires, there was much less rain fall, which reduced hydraulic generating capacities significantly. In Quebec, electricity programs had to be curtailed and electric powered steam boilers taken out of service. More power had to be generated with fossil and nuclear fuels. According to Environment Canada snowfall decreased 10% in Canada over the past decade.

In 1989, seasonal total heating energy requirements were 89% of normal in British Columbia, 91-113% across the Prairies (west to east), 119% in southern Ontario, 121% in southern Quebec and the Maritimes and 104% in Newfoundland.

In the record breaking month of December, heating requirements were 18% higher than normal in Winnipeg, 31% higher in Toronto, 35% higher in Montreal and 32% higher in the Maritimes. General manufacturing operations thus used significantly more energy, which did not help their operating efficiency.

Energy Prices and Costs

It is estimated that CIPEC participating companies spent about $9.2 billion for fuel and electricity during 1989. This would have been $4 billion higher if there had been no efficiency improvements, energy conservation, changes in product designs and energy price reductions brought on by deregulation and self-generation, etc.

The value of primary energy production in 1989 (Cansim #EET8CCA) amounted to $39,459 million, of which the total manufacturing and mining industries spent some $12,903 million (32.7%). CIPEC participants accounted for about 72% of the total industrial energy expense.

Table IV
Average Sector Energy Costs
$ per Gigajoule

Chemicals	4.00
Electrical	6.81
Ferrous Metals	3.05
Food & Bev.	7.07
General Mfg.	6.27
Ind. Minerals	4.90
Machinery	6.77
Mining	6.24
Pet. Refining	1.96
Plastics Proc.	7.79
Pulp & Paper	6.57
Textiles	5.92
Trans. Mfg.	6.01
Wood Prod.	8.39
CIPEC Average	4.53

Average energy prices vary considerably throughout the provinces, as shown in Table III, because of the abundance of indigenous resources and local pricing policies.

The resulting aggregate energy cost for each of the different sectors is shown in Table IV. Sector costs vary because of the different share of energy, use of wastes, locations and type of contract rate structures. Thus the stimulus for energy conservation in the participating sectors shows considerable variation.

Table III
1989 National Average Industrial Energy Prices $/GJ

	Nfld.	PEI	N.S.	N.B.	Que	Ont	Man	Sask	Alb	B.C.	Canada
Elect.	15.60	16.27	13.30	11.78	9.16	12.70	8.61	10.66	9.00	8.85	12.72
Oil	7.90	7.51	6.97	8.00	7.46	8.02	8.17	3.66	—	7.87	7.71
N.G.	—	—	—	—	4.80	4.27	3.66	3.75	1.87	3.31	3.37

Source: EMR Handbook

1. Electricity – Industrial monthly consumption of 3,100,000 kWh
2. Fuel Oil – Retail domestic prices
3. Natural Gas – total sales. Average price for large companies is $2.45/GJ ($.091/m ^{3})

Initiatives for Energy Conservation

Overview

The neutral performance in 1989 is one more indication that business is slipping into a recession similar to the one that occurred in 1981-1982. At that time energy-use efficiency, which had advanced at about 2% per year, slowed to a 1% gain in 1981 and lost 1% in 1982. Then, a resurgence of productivity enhancements, business rationalizations, tighter budgets, leaner organizations, etc., together with steadily improving business conditions, restored the energy efficiency gains to 2% per year until 1989.

Between the 1983 and 1988 growth years, energy efficiency was closely linked with general improvements in production output, gradual rise in capacity utilization and general increases of investment in new equipment and innovative technologies. All through this period there were underlying unmeasurable benefits occurring from the changing mix and redesign of many of industry's products. For example, while no definitive study has been done on the Canadian situation, the United States Department of Energy estimates[4] that 18% of the U.S. national reduction in energy use comes from an industrial-mix shift factor while 20% is due to more efficient manufacturing techniques. A similar pattern is thought to exist in Canada.

In recent years new significant factors have emerged in the industrialized world that will have a major impact on energy use and future efficiency. Unquestionably, the most important is a genuine concern for protection of the environment. The shape and pace of globalization is quickening with the emergence of larger and stronger trading blocks. Each country is having to restructure to be able to offer special economic and energy related strengths to suit the requirements of these new trading associations.

As well, governments of industrialized nations are also having to cope with soaring deficits and are now struggling to redefine their future energy policies including the extent of intervention in their countries' energy affairs. Nearly all member countries in the OECD International Energy Agency (IEA), of which Canada is a member, are beginning to formulate new national energy policies and strategies to place more emphasis on energy conservation. In all OECD countries, energy conservation is seen as the cornerstone of environmental improvement. Many countries also see energy conservation as the least-cost means of righting the balance between supply and end-use, not only for national security reasons, but also as a way to avoid the huge costs in subsidizing unnecessary "megaprojects".

In Canada in the past few years, one of the strongest motivating factors for energy conservation – price – has been soft. This has been primarily because of self-sufficiency, market deregulation and the workings of free-market forces. In 1988, for example, real costs of energy[5] to Canadian industry dropped 0.9% (oil products went down 2.0%, electricity increased 15.7%, natural gas dropped 15.0% and coal went down 8.2%). In other OECD countries, the composite price dropped 3.4% in the United States and 1.7% in Japan, but went up 1.3% in Germany, 5.4% in Italy, 10.6% in Sweden, 14.6% in Belgium and a jolting 34.5% in the United Kingdom.

Not since the last oil "shock" in 1979, when spot-oil prices rose to $45 a barrel, have energy prices been a real driving force in international and domestic energy conservation programs. The motivation for improving energy conservation has therefore slackened and performance has suffered.

[4] Energy Policies and Programs of IEA Countries, 1989 Review, International Energy Agency, Paris.

[5] Source. IEA prices with taxes adjusted to a common base.

Energy and the Environment

At the 1989 annual meeting of the federal and provincial energy ministers, the topic of greatest interest was the Intergovernmental Task Force on Energy and the Environment's recommendation to set a target of 20% reduction in CO_2 emissions by the year 2005. The task force estimated that CO_2 emissions from domestic consumption of fossil fuels will rise nearly 50% from the 1988 level of 473 million tonnes to 706 million tonnes in 2005.

An independent study (DPA Consulting Group, Toronto) of the techniques and costs of meeting this ambitious goal pointed to three levels of effort. The first step would involve use of operating cost inducements to improve combustion efficiencies, shift to lower carbon-emitting fuels like natural gas, replace coal and oil-fired generation of electricity, etc.

The second level would require some financial incentives to raise economic returns to industry standards. In this endeavour, emission reductions could amount to 160 million tonnes per year and save $159 billion ($108 billion after capital costs are netted out).

Step three – further reductions of 234 million tonnes – could be achieved by introducing measures based on technologies now being developed. This effort would require some $100 billion investment, but a net $72 billion in savings (not including the benefits of environmental improvement) would come from a $177 billion reduction in energy cost.

The Task Force concluded that the most cost-effective means of reducing CO_2 emissions is through energy conservation and improved efficiency.

Potential Annual Energy Savings

According to the results of the latest Ontario Ministry of Energy Industrial Energy Services Program (IESP) survey, there is no shortage of quick-return opportunities in the manufacturing and mining industries.

This highly successful program, that focuses primarily on quick-return retrofits, has identified average annual savings of 9.5% from retrofits with simple economic paybacks of less than 1.9 years. A large number of longer payback improvements have also been found, but these have not been included in this high priority list.

The most frequent retrofit opportunities still being found by the Ontario IESP program are shown in Tables V and VI. Improvements to electrical systems provide 1.6 year simple paybacks on investments, HVAC systems yield 2.4 year returns, combustion system improvements have 1.9 year returns, steam systems provide 1.1 year paybacks, production scheduling can yield 0.9 year paybacks and process alterations using known technologies have great potential with only 1.9 year paybacks on new investment.

The quickest techniques still involve reducing steam system pressure and repairing steam traps. This situation hasn't changed much since CIPEC monitoring began 14 years ago, because the majority of quick-return opportunities require constant maintenance to be effective and always become more viable as energy prices increase.

With these kinds of opportunities and short economic returns, it is evident that performances could improve with more staffing, more widespread monitoring and control and a modest adjustment in capital budgets.

Table V **Energy Efficiency Opportunities**

Source	Number	Capital Cost ($,000)	Annual Savings ($,000)	Simple Payback (years)
Electrical	402	13,609	8,520	1.6
Space Heating	271	8,981	3,827	2.4
Combustion	233	9,572	5,139	1.9
Steam Systems	96	1,751	1,578	1.1
Scheduling	44	556	636	0.9
Process Changes	330	32,523	17,062	1.9
Miscellaneous	82	5,830	4,964	1.2
Total	1,458	72,822	41,721	1.8

Source: Ontario Ministry of Energy

Table VI **Top Ten Energy Efficiency Opportunities in 315 Plants**

	Number	Annual Savings ($,000)	Percent of Total
1. Process Design/Operations	53	4,409	10.8
2. Heat Recovery from Process Streams	84	4,069	9.9
3. Demand Controller/Load Shedder	102	3,547	8.7
4. Heat Recovery from Boiler Stack	92	2,712	6.6
5. General Lighting Improvements	160	2,691	6.5
6. Heat Recovery from Process Equipment	32	2,437	5.9
7. Process Equipment Replacement	25	2,404	5.8
8. Process Heat Recovery for Space Heating	50	1,097	2.7
9. Boiler Air/Fuel Controls	57	891	2.2
10. Power Factor Improvements	101	759	1.8

Source: Ontario Ministry of Energy

Spending on Energy Efficiency RD&D

Canadian industry's long-term energy-use and efficiency is also directly affected by the rate of national RD&D spending and the effectiveness of technology transfer activities.

The overall level of energy R&D spending in fiscal 1987/88 (latest available) was $902 million, of which $489 million was spent in industry – $327 million by the federal government and $86 million by the provincial governments. Federal government spending consists of funding of nuclear R&D (45%) expenditures co-ordinated by the interdepartmental Panel on Energy Research and Development (PERD) (27%) and other agencies (28%). PERD funding includes a broad array of subjects including oil sand/heavy oils, coal supply and combustion, oil/gas/electricity development, new liquid fuels, energy conservation and renewable energy and nuclear fusion. In recent years, there has been some shift in emphasis from fossil fuels to energy efficiency, alternative energy sources and the environment, but the major emphasis is still heavily weighted on supply and development of expensive new sources.

As well, the federal government budgeted $253 million over 5 years for Energy Efficiency and Diversity (EED) initiatives to further promote efficiency, increase the penetration of viable energy alternatives, improve energy's impact on the environment and support these initiatives with near-term low-risk R&D efforts. But under EMR's modified new mandate, activities are now becoming more information oriented (intelligence, technology transfer, standards, etc.) and less involved with promotional programs.

Provincial R&D priorities follow particular local interests. Alberta, with its emphasis on fossil fuels, accounts for about 70% of the provincial energy R&D expenditures. Quebec has a substantial program related to the further electrification of the province. In eastern Canada, coal is the focus of attention. Other provinces tend to concentrate on energy efficiency and renewables.

In comparison with other OECD countries' spending, Canada's energy analysis budgets are shown in Table VII. Since 1983, Federal government actual spending on energy systems analysis has decreased by 75%.

Status of Energy Conservation

In view of these circumstances and the rise of environmental concerns, several task forces asked participants to rank the importance of energy-use efficiency, remaining sources of improvement and barriers to future improvement. The remarkably uniform responses among surveyed groups only differed in relative weight given to the identified issues and minor realignment in some of the source items special to each industry. The general manufacturing aggregate results are shown in Table VIII. In the past few years, energy management programs had gradually evolved into specialized energy management activities where the emphasis was mainly on reduction of operating expenses, administration of natural gas "buy-sell" contracts, etc. With the rise of environmental concerns, however, companies are now in the process of revising their strategies and again looking at the broad implications of energy use, including attendant waste disposal problems.

Many progressive Canadian companies have now combined energy and environmental affairs into one senior job responsibility. Many firms have also reactivated per-

Table VII **Government RD&D Budgets for Energy Systems Analysis (in millions of $U.S.)**

	1983	1984	1985	1986	1987	1988	1989
Canada	20.6	16.7	8.9	8.1	6.9	5.4	5.3
U.S.	386.7	349.7	430.5	402.1	357.3	405.2	413.8
Japan	54.2	60.8	34.5	25.6	27.3	20.3	17.7
Germany	24.1	4.2	2.9	5.3	n/a	0.1	0.2
Netherlands	15.8	15.4	15.7	17.4	21.6	21.4	22.2
Italy	13.3	25.6	14.4	30.2	165.0	225.0	261.0
Sweden	15.2	11.1	15.7	16.5	15.7	21.5	18.7
U.K.	66.0	62.3	65.5	32.7	30.7	33.9	27.2

Source: IEA country submissions.

Table VIII **Status of Energy Management**

General Concerns		Improvement Sources		Barriers	
Product Quality	88.3	Monitoring & Control	64.4	Economic Payback	76.5
Safety & Health	84.1	Process Technology	62.5	Other Priorities	56.5
Profit Improvement	82.9	Housekeeping & Maint.	58.7	Staff Limitations	56.8
Labour Productivity	80.6	Electrical Systems	52.5	Uncertain Business	52.9
Plant Equipment	68.2	Combustion Systems	51.5	Technical Constraints	52.3
Pollution	67.6	Other Utilities	50.6	Impact on Occupants	51.7
Energy Efficiency	62.9	Buildings	50.6	Government Incentives	51.1
Raw Material Prices	61.1	Waste Heat Recovery	50.0	Detailed Information	41.1
Training	55.3	HVAC	41.8	Impact on product	37.6
R&D	37.6	Materials Handling	33.3	General Awareness	28.8

formance auditing on a broader scale. The status and profile of the Triple-E manager (engineering, energy, environment) is now on the rise.

From the survey response, the alignment and weight given to each item suggests that industry is still very much preoccupied by immediate operating concerns. Product quality gets three times as much attention as R&D, and monitoring and controls are higher priorities than implementation of complicated retrofits – especially when economic paybacks are long and corporate resources are limited.

But as a result of growing competitive pressures, staff limitations and greater technical complexities, more companies are turning to provincial energy auditing programs and electric utility DSM programs for technical and financial assistance.

Electric Utility Demand Side Management Activities

Perhaps the most significant initiatives that will help raise future energy-use efficiency, and thereby help improve the environment, are now contained in the various Demand Side Management programs[2] conducted by the provincial governments and local electric utilities. These comprehensive programs are geared to the specific needs of all their constituents, and because of their specific goals, promise measurable and well-balanced results. In general, they offer focused promotional activities, professional assistance, specific financial incentives and regular impact assessments. This approach usually constitutes a recipe for sustainable results.

Industry therefore has a vital interest in the cooperation and success of these DSM programs, not only because more than half of its energy cost is now spent on electricity, but also because of social and economic impact involved in providing the "least-cost" sources of future power.

What's more, since most conventional electricity generating facilities are only about 35% efficient, the multiplying effect of reducing industry's end-use demand also helps lower the amount of "greenhouse" gases emitted to the environment. It therefore means that industry will have an extended responsibility for environmental protection beyond the limits of its own property.

The following is a summary of the current DSM programs:

British Columbia

The B.C. government recently introduced the Industrial Electricity Rate Discount Act (Bill 28), and the Critical Industries Act (Bill 31) to help industry with reduced power rates. These programs will be replaced within 3 years by strategic conservation measures.

The B.C. government also intends to deregulate electric power production. It has therefore set the state for Independent Power Production (IPP) in the province. Investor-owned utilities can generate electricity and directly negotiate contracts with large customers. B.C. Hydro is required to wheel power from independent generators as well as that generated by companies for use in their own subsidiary operations.

B.C. Hydro's annual output varies between 42,500 GW.h and 52,000 GW.h depending on hydraulic conditions. An additional 3,200 GW.h can be provided from existing thermal plants. The total average cost of operating the system is about 4.0 cents per kWh. There is no surplus beyond the normal amount required for reliable supply, planned maintenance outages, etc.

B.C. Hydro therefore has a 24 point comprehensive DSM program now in operation and intends to invest $345 million (30% for industry) to reduce consumption by 48,000 GW.h over the next 20 years. This will displace 800 MW of equivalent generating capacity.

[2] "Demand Side Management in Canada", published by Energy, Mines and Resources Canada and Canadian Electrical Association.

Cogeneration is seen as a major way of providing power to ratepayers at costs below that of conventional new facilities. Most of the existing cogeneration is in the pulp and paper industry (470 MW) and wood products industry (75 MW). In 1989, 35 submissions were presented for IPP projects totalling some 1,795 MW of non-utility power.

West Kootenay Power and Light Company Limited is a privately owned utility with 4 hydraulic stations plus access to power generated by Consolidated Mining Ltd. and B.C. Hydro. However, West Kootenay is planning to reduce its purchased power and also has introduced a comprehensive DSM program.

Alberta

The Alberta government does not have an official DSM policy but does provide a wide range of energy awareness activities.

Alberta Power Ltd. is a publicly owned company that generates about 1,224 MW from 7 interconnected thermal plants fired by coal or natural gas. Industry uses 60% of the total capacity. The utility anticipates retail sales will grow about 7% per year until 1994. Cogeneration is actively promoted. Rate structures include TOU and incentives for peak clipping.

TansAlta Utilities Corporation is also an investor-owned company with 3 large coal-fired and 13 hydraulic facilities. Industry uses 47% of the total 4,293 MW generated. DSM incentives concentrate on rate structures that promote the wise use of electricity.

Edmonton Power is the largest municipally owned utility in Canada. Two gas fired 1,208 MW plants provide peaking power to supplement purchases from neighbouring utilities.

Saskatchewan

The Saskatchewan Power Corporation provides about 12,969 GW.h of power from 5 hydraulic, 4 thermal, and 3 gas turbine facilities. In addition, SaskPower uses diesel generators to produce some off-grid power. Cogeneration potentials are being studied.

SaskPower's DSM initiatives centre mainly on provision of interruptible and off-peak rate structures and purchase of a limited supply of power from independent generators. This amount is currently limited to 50% of the new growth in demand.

Manitoba

The Manitoba government supports a number of DSM-type initiatives which focus on strategic methods of conservation. These include free audits, advice on implementing energy management projects and programs and energy awareness activities. A target of 100 MW reduction over the next 12 years has been established.

The capacity of Manitoba and Winnipeg Hydro is about 3,900 MW from 13 hydraulic and 2 coal-fired thermal facilities. It is anticipated that capacity will be in a surplus position – low water levels notwithstanding – until 1999.

Industrial DSM activities are concentrating on end-use efficiencies, ground source heat pumps and electrotechnologies.

Ontario

The province of Ontario operates an extensive list of programs designed to suit the needs of industry and other sectors. These include a comprehensive industrial energy auditing program, an energy monitoring demonstration program and an energy technology development program.

In its energy policy paper entitled, AN ENERGY EFFICIENT ONTARIO: TOWARD THE YEAR 2000, Ontario's key objectives are stated as follows:

- Energy efficiency and conservation will be the major priority in meeting the province's future needs for energy services;
- DSM programs will be used to extend the time before Ontario needs new electrical facilities;
- The potential for strategic conservation is estimated to be 1,000 to 4,000 MW of peak reduction by the year 2000;
- Programs will be designed to motivate end-users to conserve energy before having to add new generating facilities, taking due consideration of environmental and other social costs;
- Ontario Hydro and the municipal utilities will play a lead role in improving the energy efficiency of Ontario; and
- The government will coordinate the energy efficiency activities of the utilities.

Ontario Hydro, with 68 hydroelectric, 9 thermal and 3 nuclear facilities has a generating capacity of about 30,333 MW. According to Ontario Hydro, recent annual growth in peak demand has increased about 5% but is expected to subside to about 2.4% per year in the 1990s. According to Hydro studies[3], even with a proposed new 3,500 MW nuclear plant, surplus capacity is not considered sufficient past 1995.

Ontario Hydro therefore has launched a comprehensive DSM program designed to avoid 4,500 MW of generating capacity by the year 2000. A further 750 MW of loads has been identified for selective interruption when necessary.

Ontario Hydro plans to spend $917 million on DSM between 1990 and 1994. By the year 2000, Hydro's total commitment could be as high as $2 to $3 billion.

[3] Ontario Hydro, Providing the Balance of Power, 1989

Hydro estimates that 73% of industry's consumption is used for motor loads, 16% is used for process heat and electrolysis, and 11% is used for lighting.

Hydro's industrial DSM activities will focus on load shifting, peak clipping and conservation. The program includes a full array of information activities, incentive driven programs in the early 1990s and broader scale implementation initiatives in 1993. DSM potentials of 150 – 1,000 MW of parallel and cogeneration, 400-750 MW of load shifting and 200-700 MW of general efficiency improvements have been identified as goals for the year 2000.

Industrial users with large motor loads will get high priority attention. Introduction of TOU rates in "direct customers" will be gradually extended throughout industry. End-users that are candidates for load shifting, especially in the cement, chemical and pulp and paper industries will also receive special attention. Energy management/audit programs will cover all sectors.

Where Independent Power Production (IPP) is involved, which will increasingly involve industrial firms, Hydro will base buy-back rates on the "avoided-cost" concept. For example, the cost of adding new generating facilities, according to Hydro's "Demand/Supply Plan Report" (Chapter 6) amount to some 3.4 cents/kWh for independent high-load factor gas-fired cogeneration and 5.3 cents/kWh for construction of new hydraulic generating facilities. However, Hydro recognized other extenuating circumstances, such as the constrained distribution systems in certain regions, time of availability, reliability, etc.

Quebec

The province of Quebec, through its Bureau de l'éfficacité énergétique (B.E.E.) has a number of programs relating to energy efficiency. Industrial DSM activities emphasize strategic conservation, load shifting, and peak clipping. An industry-commercial technology-transfer program, a technology demonstration program, and free technical audits are provided.

The main feature of Hydro-Quebec's DSM program is to apply planned interruptible contract options more frequently, which could enhance the overall cost-benefits to end-users and the utility by limiting peak demand. Interruptible power is to increase from 760 MW to 1200 MW by 1996.

New Brunswick

The provincial government believes that energy is a key instrument to be used in promoting and managing its economy. Accordingly, a loan program exists to promote energy conservation and use of alternate resources to displace purchase of foreign oil. For example, private interests have been invited to bid on building, owning and operating a model 25 MW wood-fired power plant.

New Brunswick promotes energy efficiency through information services and provides on-site audits. Several R&D programs, including demonstrations, are sponsored.

The New Brunswick Electric Power Commission generated some 12.4 million MW.h in 1989 from nuclear (35.3%), hydro (14.1%), oil-fired (39.5%) and coal (11.1%) plants. Adequate surplus capacity exists until 1996-97. Industrial DSM activities have the highest savings potential and will concentrate on cost-effective peak clipping efforts.

Prince Edward Island

The province has formulated long-term DSM type policies to provide the "least-cost" options for power to reduce its dependence on foreign oil, promote wood-fired cogeneration and better manage loads in its commercial and industrial sectors. The province subsidizes electricity costs of approximately 100 of P.E.I.'s key manufacturing and processing companies.

Because of DSM initiatives, the Maritime Electric forecast of long-range demand increases should be held to 2.9% per year. Broader application of interruptible rates is discouraging the equivalent of 14 MW while the "Beat the Peak" program is saving 2MW of peak demand. The industrial interruptible rate structure is reducing MEL's firm demand by 11%. A centrally controlled load reduction system was installed in 1989.

Nova Scotia

The province sponsors a number of EE/DSM initiatives for industry's benefit. These are focused mainly on demonstrations related to alternate fuels, point-of-use audits, an energy award program and, through the Public Utilities Board (PUB), the start of appropriate DSM activities.

The Nova Scotia Power Corporation set a new peak generation of 1,707 MW in December of 1989. The 1989 load forecast projects a 10 year annual growth of 3.5%. DSM actions have been identified as one of the means of dealing with the expected shortfall of capacity at the turn of the century.

Newfoundland

Newfoundland and Labrador Hydro (NLH) generates some 1,417 MW from the island and 5,400 MW from its Churchill Falls mainland source for sale to Newfoundland Light and Power (NLP) and Hydro-Quebec. Blessed with an abundance of hydraulic potential, NLH plans long-term expansion with short-term makeup from other sources, including purchase from independents such as Abitibi Price.

NLP is in the conceptual/development stages of formulating a DSM program. Ground-source heat pumps, energy-efficient lighting and general energy efficiency methods are contemplated.

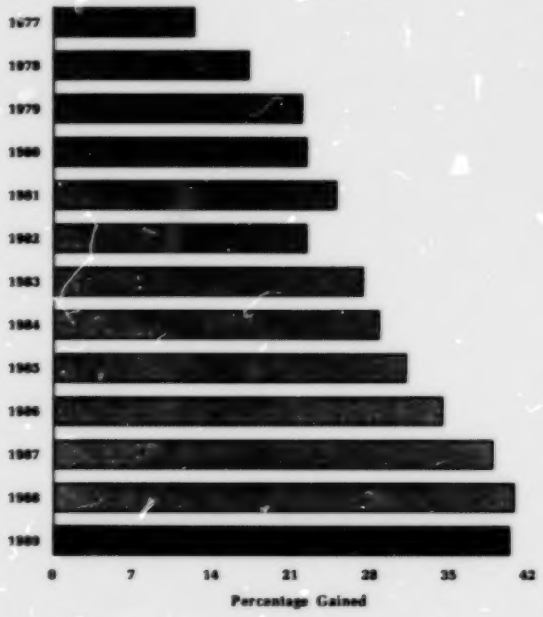
Yukon and North West Territories

The territorial governments offer a number of focused programs to promote general conservation but do not have DSM policies at this time.

Chemical Industry

Energy Conservation Task Force

David Shearing
Chairman



The chemical industry is the third largest energy consumer and has the fourth highest energy intensity per GDP of all of Canada's manufacturing industries. Chemical producers use 15.5% of the domestic secondary-energy demand, exceeded only by the pulp and paper and steel making industries, and equal to the total energy consumption in the mining industry.

The efficiency results contained in this report are based on a survey of the Canadian Chemical Producers' Association (CCPA) membership which represents about 80% of the total industry. This survey includes a broad spectrum of companies including those that spend less than $100,000 for fuel and electricity as well as large integrated firms that spend over $200 million on energy and feedstocks.

Based on the value of shipments, 63% of products from this industry are classified as petrochemicals, 25% as inorganic and nearly 12% as organic and specialty products. Eleven percent of the industry is located in British Columbia, 29% in Alberta, 41% in Ontario, and 10% is in Quebec.

1989 Performance

Energy efficiency declined 1.6% in the surveyed companies during 1989. This performance drop lowered the group's overall gain to 39.4% since the original 1973 base year and 8.3% since the updated 1985 base year.

The sluggish performance started last year when efficiency gained only 1.5%, whereas the usual increases average about 2.2% per year.

Energy efficiency was affected by a number of business and related operating factors that began to cloud the industry in 1988. The main factors include a decline in production output and reduction in capacity utilization. Together with a slower rate of investment in 1988 and a drastic drop in profits in 1989, operating conditions and consequent energy performance appear to be a repeat of the situation during the 1975-1982 business cycle.

The strong link between energy efficiency trends and changes in capacity utilization with production levels is evident from similar results reported during the 1975-1982 business cycle. In 1982, energy efficiency dipped 2.6% when production went down 11% during the year. Since then, energy efficiency was pushed up 17% while capacity utilization increased from 71.9% to 94.4%. The impact of changing capacity utilizations is not as great as before because of a broader base of commodities and better control of plant operations. However, energy performance suffers when all conditions are unfavourable.

During 1989, production was flat for most companies in the inorganic and specialty sectors while output in the petrochemical group was hit the hardest. In the petrochemical sector, output was off 8% while the total industry drop was 6.6%. Faced with rising interest rates and slower sales, companies had to reduce output knowing that energy efficiencies would slacken at the lower operating rates.

In 1989, total end-product sales dropped to $9.04 billion from $10.02 billion in 1988. Profits (before interest, taxes and special write-offs) declined from $3.1 billion to $1.85 billion mainly because of a rapid slump in petrochemical prices. Due

to a world-wide oversupply of some commodities such as ethylene and methanol, it will take time to adjust to this changing global market situation. Profits in the Canadian industry are expected to slide a further 32% in 1990. In this depressing situation, companies trim operating expenses, cut discretionary projects, mothball old plants, slow the rate of new investments, reduce staff and wait for a more favourable time to advance.

The investment rate on new equipment has a large impact on performance even though there is an approximate two year time lag in performance results. Reduced 1989 energy efficiency would have been affected by the slow 1.4% rate of growth in investment in 1987-88. However, the effect of a record high $1.5 billion (up 41%) rate of investment in 1989 and a forecast of a like amount for 1990 may help restore energy gains to previous levels.

There is also a noticeable drop in the reported number of small retrofits because of growing capital intensity, higher interest rates, and greater business uncertainties. Introduction of a 7% Goods and Services Tax (GST) will also reduce the purchasing power of the consuming public, which could dampen a return to a more profitable situation.

The relationship between capital spending on energy performance and other concerns, such as the environment, is drawing close attention from government in its endeavour to set new policies affecting these issues. According to a special study[1] by Statistics Canada, the entire manufacturing industry is spending only about 1% ($151 million in 1987) of its new capital investment on specific projects that reduce energy operating costs.

According to the study, the chemical industry spent $2.025 billion on new equipment between 1985 and 1987 of which 61% went towards capacity expansion and 28% for modernization.

The chemical industry, unlike many general manufacturing industries, must spend a high percentage of its investment on energy improvements because of the nature of its processes and capital intensity of its equipment. Given some of the highest energy intensities, total fuel and electricity cost estimated at some $1.3 billion in 1989, and energy costs that can amount to as much as 70% of total manufacturing expenses, continued investment is critical to future competitiveness. It is estimated that close to 20% of all new investment has a direct impact on energy operating efficiency. The numerous retrofits and expansion examples detailed in this report in previous years demonstrate this pattern. A definitive recent example of this ratio was contained in the Cargill/Manitoba government nitrogen fertilizer plant announcement. At a cost of $379 million, $29 million was identified as design enhancements intended to increase the energy operating efficiency.

The Statscan study also shows the entire manufacturing industry is now spending twice as much on environmental improvements as for energy related projects. While the pattern within the chemical industry is not clear, undoubtedly there is considerable environmental investment given the new industry-wide "Responsible Care" program. In isolated cases, companies already report that energy performance suffered directly because of environmental retrofits. In other cases, energy utilization improves as a by-product of environmental investment. For example, Du Pont Canada Inc. has created a viable new plastic fencing business using recycled materials. As well, Du Pont has announced that it will reduce by half all potentially toxic emissions from its operations within five years and, where possible, safely use the recovered wastes as boiler fuel.

On a broader perspective, there is a global chemical industry capital/productivity upgrading trend under way. Emerging free trade blocks, such as the European Economic Community, and political changes in Eastern Europe are changing the face of international competition. Even though Canada's chemical industry is helped by an abundance of cheap natural gas, energy costs are increasing faster (6.2% in 1989) while raw material costs dropped 7.2% and other major factory expenses remained stable. This situation should cause industry management to focus renewed attention on energy performance with beneficial effects.

The Canadian chemical industry itself is in the midst of a major restructuring which has resulted in difficulty in tracking annual performances. An increased number of levered acquisitions, privatizations, divestitures, etc., has created a volatile situation in which some of the regular participants could not respond to the survey this year.

The 1990 forecast improvement level of 40% that was surpassed last year, then lost this year, may yet be regained if business volumes stabilize and the impact of more efficient plants brought on by the large investment in recent years begin to pay off.

Energy Consumption and Costs

Consolidated energy use trends are shown in Table I below. Results show there has been a 6% share increase in the use of natural gas in the past four years, half of which resulted from the substitution for fuel oil and the other half because of increased feed stocks in the petrochemical industry. Energy efficiency is determined on the basis of fuel and electricity consumption and normally does not account for changes in feed stock consumption.

There was also a slight increase in use of natural gas with a corresponding reduction in propane because of cost differences.

The growth of the electrical share was slower in 1989 partly because of the conversion of some electric steam boilers back to fossil fuels in Quebec. Hydro Quebec has brought

[1] Analysis of the Categories of Capital Investment, 1985-1987, Statistics Canada

Table I

Chemical Industry
Energy Use and Trends

Type	Units (,000)	Gigajoules	1989	1985	1980
Natural Gas	5,346,017 m^3	198,871,870	51.0	44.4	36.8
Electricity	9,935,570 kWh	104,830,200	27.0	34.7	31.1
Liquid Petroleum Products:					
Distillate Oil	83,136 litres	3,378,800	1.0	0.9	10.0
Residual Oil	176,508 litres	7,462,400	2.0	4.2	14.4
Diesel and Gasoline	11 litres	459	—	0.5	0.4
Other Fuels:					
Propane, LPG	163,782 litres	4,356,600	1.8	1.0	—
Coal & Coke	51.7 tonnes	1,200,000	0.4	0.3	2.3
Steam	n/a	10,630,635	3.3	2.0	1.0
Other Fuels	n/a	57,661,300	15.0	12.0	4.0
Totals –	1989	388,383,290			
–	1988	381,712,677			
–	1987	428,905,604			

Other fuels include process by-products, vent gases, "drips", "slops", pitch, sulphur, hydrogen, waste oils, etc. Electricity is converted at 10,551 kj/kWh.

back some incentive contracts to temporarily discourage electrical consumption because of the low water levels in its hydraulic generating facilities.

The shifting share trends are similar when electricity is converted by the net 3600 gigajoules (GJ)/kWh rates. Using this net rate, share distributions change to: electrical 12%, natural gas 61%, fuel oil 3%, propane 2%, purchased steam 5% and 17% for wastes used as energy. In either case, the cost share for electricity amounts to 33% of the total estimated $1.35 billion energy expense.

Additional recovery and use of "waste" fuels has had a major impact on energy conservation performance and cost reduction. Between 1985 and 1988, the growth rate slowed to half of its former rate. In 1989, however, the rate jumped again as companies such as those noted above have renewed efforts towards recovery as part of their environmental control programs. Even so, many companies are recycling more by-products into processes for recovery.

Table II

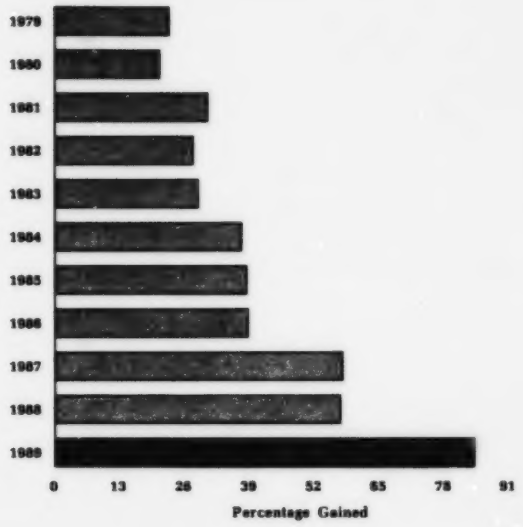
Chemical Industry
Energy Efficiency Improvement

Current year (1989) total energy inputs		388.383 terajoules
Base year (1985) equivalent energy inputs		418.763 terajoules
Adjustments (1985-1989)		.930 terajoules
Net Improvement	= 9.38%	
Efficiency gain 1973 - 1985	30.0	
1986	4.4	
1987	5.2	
1988	1.5	
1989	–1.6	
Total gain 1973 - 1989	39.6%	

Electrical and Electronic Industry

Energy Conservation Task Force

Steve Horvath
Chairman



"A banner year". This phrase best sums up the electrical and electronic manufacturing industry's 1989 experience on all fronts. Energy management was no exception.

The 49 companies submitting energy consumption data for this Task Force summary reported a record 34.7% improvement in energy efficiency for 1989 compared to 1988. Task Force members attribute this significant result to three factors:

- **A banner year in productivity:** If 1988 was a great year, 1989 surpassed every manufacturer's expectations. Production levels, in response to consistent high demand for products, rose to all-time highs; plants operated at almost full capacity – topping the 95% level.

  Because the electrical and electronic manufacturing industry uses relatively little energy to actually manufacture its products (most energy is used for heating, lighting, etc. which vary only slightly when production levels rise), increased output dramatically improves the energy efficiency picture for companies in the industry. A number of companies thus were able to report energy efficiency improvements in the magnitude of 30, 40 and even 50%.

- **Rationalization of company operations:** In response to the challenges of the global marketplace, companies are looking at any number of ways to improve effectiveness in their production operations. In the electrical and electronic industry, this often takes the form of product rationalization; a company will produce a high quality product in the most cost efficient method in order to supply the global marketplace. This too has a positive effect on productivity – thus helping improve the reporting company's energy statistics.

- **A change in the reporting base:** Although the number of reporting companies in 1989 was lower than in 1988 (when 58 participated), the actual reporting base has changed significantly. This reflects a major realignment that is taking place in the electrical and electronic industry itself. Twenty-one companies which contributed to the 1988 survey did not provide statistics for this 1989 report. Many are major energy consumers involved in mergers, divestitures of product lines, sell-offs and other reorganizational activities which caused a disruption in the reporting of their energy usage.

The 13 new companies participating in the 1989 survey contributed significantly to the industry's improved energy efficiency picture.

Energy Use Patterns

Total energy used by reporting members dropped sharply in 1989 to 4.6 million gigajoules (GJ) from 7.07 million GJ the previous year. Despite this drop, the relative distribution of energy sources remained fairly constant, with natural gas and electricity being the preferred energy sources. Oil consumption increased to just over 7% from 2%. This trend can be partly attributed to the relatively low price of oil during the past year.

E & E Industry and the Task Force: A Challenging Future

The more than 200 companies represented by this task force manufacture a diverse range of products used in the generation, transmission and distribution of electricity. Examples of this include generators, transformers, lighting equipment, wire and cable and electrical appliances. Companies represented by this task force also manufacture a variety of electronic products, systems and related high technology components. The majority of these companies are members of the Electrical and Electronic Manufacturers' Association of Canada (EEMAC), which acts as a secretariat for the task force.

Many of these E & E industry manufacturers face significant competitive challenges as global competition and free trade with the U.S.A. become realities. The industry reorganization that began in 1989 and continues into 1990 and beyond is but one way in which the industry is restructuring to be more competitive.

"The challenge for this task force", says Steve Horvath, Chairman of the Electrical and Electronic Industry Task Force, "is to strengthen the role of energy management. In the face of these major changes, our member companies should integrate energy management and environmental consideration directly into their manufacturing and product development decision-making procedures."

- **Put energy management back on the front burner:** As companies have reorganized to modernize and be more globally competitive, energy management has lost its identity as a significant function. This is partly because many companies already have implemented their most substantial energy conservation measures. Low energy prices in the past few years mean payback periods for energy conservation programs are often longer than other modernization projects. Energy conservation loses out in the battle for capital dollars. Increased pressure to be environmentally responsible has also meant a change in corporate priorities.

  The task force's job, in 1990 and beyond, will be to help companies understand how energy management is an integral part of the way they will have to do business in the next decade and the next century. Looming electricity shortages in many provinces will make demand side management a reality for both companies and individuals. Environmental and energy issues are often inextricably intertwined. It will be the task force's job to help drive home these messages to members and help them devise appropriate response strategies.

- **Rebuild the task force profile:** The federal government's decision to suspend CIPEC operations in 1989 put all of this task force's planned activities on hold. This report is our major activity for the past year.

  In 1990 we therefore will be in a "rebuild" mode. This task force will emphasize educational activities in 1990 – both to raise the level of awareness of energy management and increase the commitment of industry in support of the task force.

  Initial indications are promising: A tour of the Darlington Nuclear Facility and review of the Ontario Hydro Demand/Supply Plan early in the year drew more than 40 company representatives. Three more meetings are planned for 1990 featuring guest speakers on a variety of relevant topics.

The Future Outlook

Indications are that a general air of uncertainty will prevail in 1990, fuelled by the GST, free trade, high interest rates and the high Canadian dollar. In this kind of environment, capital spending likely will be curtailed sharply, a move that will adversely affect energy efficiency programs. This trend, coupled with an expected downturn in the economy and production levels, could see this task force report little progress, or even a negative efficiency factor, for 1990. Only time will tell.

Table I

Electrical and Electronic Industry
Energy Efficiency Improvement

Current year (1989) total energy inputs		4,619,121 GJ
Base year (1988) equivalent energy inputs		7,075,361 GJ
Net Improvement = 34.7%		
Adjustments — None		
Efficiency gain 1975 - 1985	36.1	
1986	1.9	
1987	16.2	
1988	–1.2	
1989	34.7	
Total gain 1975 - 1989	87.7%	

Table II

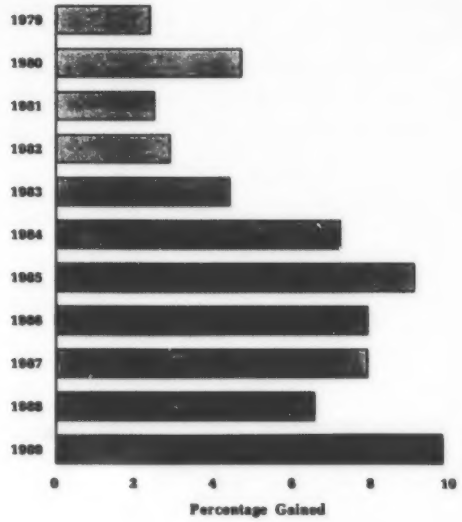
Electrical and Electronic Industry
Energy Use

Type	Units	Gigajoules	1989	1988	1987
Natural Gas	64,216,057 m^3	2,524,730	54.7	57.6	54.8
Electricity	425,738 MWh	1,620,906	35.1	36.7	41.1
Liquid Petroleum Products:					
Distillate Oil	2,959 kilolitres	114,979	2.5	1.0	0.9
Residual Oil	5,806 kilolitres	235,126	5.1	1.1	1.2
Diesel and Gasoline	403 kilolitres	15,155	0.3	0.2	0.1
Other Fuels:					
Propane	1,008 kilolitres	28,663	0.6	0.5	1.2
Steam	2,979,850 kilograms	79,562	1.7	2.9	0.7
Totals	1989	4,619,121			
	1988	6,273,070			
	1987	6,689,830			

Ferrous Metals Industry

Energy Conservation Task Force

Denis Jones
Chairman



Task Force Description

The Ferrous Metals Industry Energy Conservation Task Force is represented by the steelmakers who comprise the Ferrous Industry Energy Research Association (FERA). The companies which provided data for the 1989 energy efficiency assessment include:

1. The Algoma Steel Corporation
2. Dofasco Inc.
3. Stelco Inc.
4. Sydney Steel Corporation (Sysco)

Together, these companies represent about 70% of total Canadian raw steel production and produce steel by the following techniques:

a) blast furnace and basic oxygen steelmaking

b) electric steelmaking furnace

A partial listing of steel products would include:

- structural shapes
- rails
- flat rolled products
- forgings
- fasteners
- coated steel
- castings
- tubular products
- bar products
- wire and wire products

Steel is produced and/or processed in 23 plants operated by the member companies.

1989 Composite Energy Performance

Due to a decrease in the number of reporting companies, reported steel production declined in 1989 to 11,201,350 tonnes from 11,917,564 tonnes in 1988. All current and past statistics have been adjusted to reflect only current reporting companies.

The amount of energy consumed per tonne of raw steel was lower in 1989, at 23.23 x 10^9 Joules (J), than in 1988, at 24.38 x 10^9 J (a decrease of 4.7%).

All participating companies achieved success in their plant energy conservation programs, with a number of these achievements listed at the end of this report. Some of the major gains were a result of:

- Reduced hot metal proportions in the steelmaking process
- Continuation of the modernization programs leading to increased proportion of continuously cast steel
- Increased proportion of steel produced by the less energy intensive electric arc furnace method

Progress Towards the 1990 Energy Rate Goal

In 1989, the energy rate at 23.23 x 10^9 J/tonne was 0.8% lower than

the 1985 base year energy rate of 23.42 x 10^9 J/tonne and is 5.6% higher than the 1990 energy goal of 22.00 x 10^9 J/tonne.

Task Force Technical Activities

The Technical Committee of FERA provides opportunities for member companies to exchange information on conservation activities and to become involved in cooperative projects.

In May 1989, one committee member attended the IFRF ninth Member's Conference in the Netherlands. The conference theme was "Clean Combustion in Flames". Topics included:

- Past, Present, and Future of IFRF
- From the 60's Onward
- NoX Control Using Oxy-Fuel Gas Burners
- Modelling of Radiation
- Heat Transfer Calculation for Industrial Furnaces by Monte Carlo method

Direct contact with Federal government research facilities was maintained through an EMR observer on the FERA Technical Committee. On November 9th, 1989, the Committee was given an overview of CANMET's new direction to reduce the global warming trend due to the greenhouse effect.

In November 1989, contact was made with the Ontario Government's Ministry of Energy. A committee member met with the Program Supervisor of the Technology Transfer Industrial Program to discuss current government programs and exchange energy conservation case studies. Programs included:

- Energy Technology Demonstration
- Enersearch
- Industrial Energy Services Program
- Co-Generation Encouragement Program

In mid-1989, the Committee conducted a survey of the cold blast insulating practices within FERA member companies.

The Committee also compiled eight energy conservation 'opportunities' which were implemented in 1988.

Information packages were circulated among Committee members on the following topics:

- Proceedings from Variable Speed Drive Symposium hosted by Ontario Hydro
- Heat pump and Pinch Technology
- Mechanical Vapour Recompression Conference hosted by Ontario Hydro

Conservation Projects for 1990

All participating companies expect to implement energy saving measures in 1990. A sampling of the more significant items includes:

- Addition of an economizer to a large steam boiler
- Commissioning of a new electric arc furnace

1989 Energy Conservation Achievements

The following is a partial listing of energy conservation achievements by Task Force members in 1989.

Modifications to Existing Equipment

- Addition of a recuperator to a large reheat furnace
- Installation of coal tar injection equipment to a blast furnace
- Addition of waste gas oxygen monitoring equipment for improved combustion efficiency
- Installation of cold blast de-humidifiers on blast furnaces

Operating Changes

- Reduced fuel use during reheat furnace shutdowns.
- Reduced purchased fuel flows on boiler pilot flames
- Increased scrap preheating in the steelmaking vessels
- Increased charging of warm slabs into reheat furnace
- Increased production of continuously cast product.
- Increased production in electric arc furnaces.

Housekeeping and Repetitive Maintenance

- Upgrading of building roof insulation
- Steam system conservation programs (traps, leaks, insulation.)

Table I

Ferrous Metals Industry
Energy Efficiency Improvement

Current year (1989) total energy inputs		260,232 terajoules
New base year (1985) equivalent energy inputs		262,378 terajoules
Gross Improvement = –0.8%		
Adjustments — None		
Efficiency gain 1974 - 1985	9.1	
1986	–1.2	
1987	0.1	
1988	–1.4	
1989	–0.8	
Total gain 1974 - 1989	7.4%	

Table II

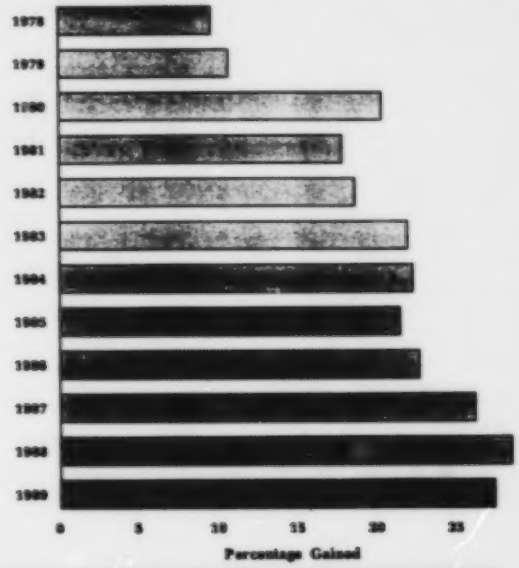
Ferrous Metals Industry
Energy Inputs

Purchased Energy	Quantity (SI units)	Conversion Factors	Energy Joules x 10 (12)	Percentage of Total 1989	1985
Natural Gas	1,190,833,000 m^3	3.72 x 10^7 J/m^3	44,299	17.0	15.6
Electricity	4,893,333,000 kWh	3.6 x 10^6 J/kWh	17,616	6.8	6.2
Residual Oil	508,617,200 litres	40.5 x 10^6 J/litre	20,599	7.9	4.4
Coal & Coke	6,128,207 tonnes	29 x 10^9 J/tonne	177,718	68.3	73.8
Total Purchased Energy			260,232		

Food and Beverage Industry

Energy Management Task Force

Alexis L.W. Hyland
Chairman



Overview of Industry

Canada's food and beverage industry consists of some 4300 companies using about 10% of all secondary energy consumed in the manufacturing sector. This highly diversified industry is composed mainly of small companies employing fewer than 50 people. Fewer than 10% of companies are large enough to practice organized energy management.

The industry is undergoing a tremendous amount of structural and technological change as a result of free trade, reorganizations, rationalizations, environmental concerns, etc. Many multi-site companies have revised their entire manufacturing strategies by introducing greater decentralization and mandating of products. As companies review their packaging and waste disposal practices, energy, which often constitutes only 3 - 15% of manufacturing costs, is undergoing yet another productivity review.

General Performance

Group energy efficiency dropped 1.7% during 1989, mainly as a result of general reductions in capacity utilizations and significant setbacks in companies undergoing major reorganizations. Consolidated efficiency has gained 27% since 1977 and 5.5% compared to the new 1985 base year. Only two previous declines have been reported – one in 1981 as a result of the general recession and the other in 1985 when breweries, distilleries and meat packing companies started to experience major capacity downturns.

Manufacturing capacity utilization in the food sector slipped 2% to 78% while only 53% of beverage industry capacity is being utilized.

Estimated cost of fuel and electricity in the surveyed companies amounts to $262 million – 38% of the $676 million spent throughout the entire industry. Energy costs would have been $70 million higher [1] had there been no efficiency improvements since 1977.

Capital investment in the industry ($2,100 million) was up 2.9% in 1989 after accounting for inflation, with the biggest spending increases in new equipment and machinery. No increase in spending is planned for 1990. According to participants' responses, only 3% of capital budgets are directed to energy saving improvements. The biggest spenders are sugar refineries and distillers, each with investment allocations above 10% of capital spending. These two groups also had the highest rate of energy improvement in 1989.

Despite the overall downturn, not all groups recorded lower operating efficiency, as shown in Table 1. The distribution of energy sources and consumption trends are presented in Table 2.

Status of Energy Management

This year, participating members were asked to rank the importance of selected items that impact on energy efficiency, the most likely sources of improvements, and some of the barriers that will affect future performance. While the list is not exhaustive, it paints a good picture of the current operating conditions throughout the food and beverage industry.

[1] This total savings figure should not be compared with previous year's since the reporting population and prices are constantly changing.

Status of Energy Management

Company Priorities		Improvement Sources		Barriers	
Safety & Health	91	Process Technology	76	Economic Payback	82
Profit Improvement	87	Monitoring & Control	75	Business Conditions	79
Product Quality	86	Waste Heat Recovery	68	Lack of Incentives	67
Pollution Problems	79	HVAC, Refrigeration	67	Technical Difficulties	56
Labour Productivity	76	Combustion systems	54	Other Priorities	50
Plant Reliability	76	Maint. Procedures	33	Staff Capabilities	50
Cost Control	71	Electrical Systems	32	Impact on Product	49
Energy Efficiency	59	Materials Handling	29	Analyzed Opportunities	37
Training	47	Air Comp. Systems	28	General Awareness	34
R&D	29	Buildings	14	Impact on Personnel	28

Safety and health remain top management concerns in the industry because of the required integrity of its products. The generally high rating given to profit improvement suggests that profit margins are still unsatisfactory. Compared to these concerns, energy management rates high, even though it is now superceded by growing environment concerns.

Regarding sources of future improvement, process technologies, monitoring and controls were the most commonly recognized. Ratings given to other items suggest that little potential remains to improve facilities, but considerable work still needs to be done on plant utilities. As energy managers progress up the scale of difficulty, solutions become more complex and expensive. This fact has been recognized by those provincial electrical utilities and government agencies offering energy efficiency auditing services. Provincial ministries of energy are now promoting process audits and allotting more time and funds to this lucrative source of energy savings.

Long payback time remains the major barrier to completing many projects. There appears to be no lack of awareness and motivation – just the means and financial resources.

Group Performances

Bakeries

Energy utilization in this sector, including Canada's largest integrated bakeries, increased by 3.8% during 1989 after reporting a 1% loss in 1988. Efficiency has gained 20.7% since the original 1979 reference year.

Aggregated energy intensity for the various products in this group remains virtually unchanged at 2,658 kilojoules (kJ)/kilogram (kg). This average energy intensity is still about 16% higher than large U.S. operations where larger economies of scale provide distinct cost and efficiency benefits.

The impact of fuel shifts is not clear because some companies had no energy supply options. However, increased consumption of electricity is a common phenomenon in all companies. The electrical power share has grown significantly from 13% in 1979 to 23% in 1989, while its share of total costs increased from 25 - 50%. This increase is due to new proofing techniques and additional product refrigeration. Future electrical growth is expected to be modest.

The group rated product quality, profit improvement, and labour productivity well above other concerns. Energy management ranked four on a scale of 10.

Biscuit Manufacturers

This survey covers 70% of all domestic biscuit manufacturing operations. There are differences in energy intensities among the reporting companies, although the average is about 5,900 kJ/kg of output. Energy costs for the processes vary from 10 - 15% of total manufacturing expense.

Energy efficiency dropped 2.1% this year and 1.7% during 1988 to lower the overall gain to 11.6% over the aggregated 1979 operating levels. Survey results indicate that few retrofits have been installed in the past three years and that most companies are relying on basic housekeeping and maintenance activities to sustain their energy efficiencies. When these activities are relaxed, performance usually suffers.

Electricity provides nearly 30% of total energy consumption and amounts to 64% of total cost. Natural gas provides more than twice as much energy (68%) while its cost is about half (35%). Consumption of fuel oil is minimal.

The pattern of concerns fits closely the table shown above. Participants said their overall attention to conservation was increasing even though energy is still considered a "low to medium" cost factor.

Breweries

In spite of several improvement projects and close attention to energy costs, breweries suffered a major setback in operating efficiency (– 5.9%) this year because of a continuing realignment of company operations. Overall business

volumes were at the same level as 1988. Energy efficiency peaked last year at 9.5% and is now only 3.4% better than 1976 operating conditions.

Two of the largest breweries merged in 1988 and this had a major impact on consolidated results. As well, several micro breweries have become better established and now participate regularly in the survey.

Energy intensities now average around 300 megajoules (MJ)/hectolitre (HL) for large operations and twice this amount for micro brewing. As a result, energy expenses vary from 7 - 15% of direct factory costs, depending on size and location of each plant.

Increased use of natural gas has pushed its share from 55% in 1979 up to the current level of 66%. The heavy fuel oil share has dropped significantly from 18% to 3% of the total mix. All the large brewers contract for gas on "Buy-Sell" agreements while micro breweries get their gas from local distributors at standard commercial/industrial rates.

Canadian breweries purchase proportionately more electricity than U.S. operations. In Canada, 24% of total energy is supplied by utilities, whereas in the U.S. only one-half as much is bought because of the common practice of cogeneration. However, in Quebec, because of low water levels in hydraulic generating systems, Hydro Quebec has introduced a new cogeneration program that will help many Quebec companies offset the high costs of purchased electricity.

The pattern of concerns in this group differs somewhat from the table above. Brewers apparently are directing more attention to development of new products (brands) and place a higher rating on process improvements than other groups in the industry.

Confectioneries

Partly because production declined significantly in 1989, energy efficiency decreased 8.5%, lowering the overall gain to 24.7% since 1981. In the past few years, confectioneries have apparently undergone more changes than any other group in the industry. Major investment in plant modernization and consolidations should soon begin to raise operating efficiencies.

The proportion of power provided by electricity (32%) and natural gas (65%) has not changed significantly in the past 10 years. Likewise, the energy intensities reported in previous years, e.g. ice cream manufacturing at about 15 MJ/kg, chocolate processing at 13 MJ/kg and other popular confections such as chewing gum at two to five MJ/kg, are about the same.

While product quality and safety and health are top rated business concerns, HVAC and process refrigeration systems were ranked highest for technical improvement.

Distilleries

Energy efficiency increased 7.3% in 1989 as a result of a similar gain in production volume and completion of some waste heat recovery projects started in 1988. In the overall picture, efficiency is 30% better than 1977 operating conditions, in spite of a 25% decline in production. This would suggest that remarkable improvements have been accomplished in this industry.

Aggregate energy intensity of distilled products is presently 39,098 kJ per (absolute) litre.

While natural gas now supplies 87% of total energy and 67% of total expense, electricity accounts for 8.9% of the energy and 30% of the cost. The only change in the past 10 years has been a 17% gain in natural gas share at the expense of heavy fuel oil. As the energy proportions indicate, the distilling process is mainly a heating operation with little electricity used in the bottling and packaging operation.

Food Processors

Aggregate energy efficiency gained a marginal 0.8% this year after recording a small loss last year. Average gain since 1976 is slightly over 2% per year.

Energy conservation in this group is complicated by the seasonal nature of production, necessity for rapid processing, and thin profit margins which often mitigate against investment in new equipment and machinery. Exposure to the full force of the Free Trade Agreement has placed many food processors in a precarious position.

Food processors generally employ extensive heating and cooling systems that require close attention in order to minimize losses. In the past, some progressive companies have installed government-supported solar heating systems to preheat water, but these are seldom successful because of the low return on investment and operating time. Large processors are now installing gas fired cogeneration units to take advantage of low gas prices and high thermal cycle efficiencies.

Food processors have made a dramatic shift from fuel oil to clean-burning natural gas. In the past 10 years, the share of heavy fuel oil has decreased from 57 - 17% while natural gas has shot up from 20 to over 61%. The electricity share has remained stable near 20%.

Fisheries

1989 was a depressing year for energy utilization in this sector

because of lower production volume (– 2.8%), factory shutdowns and attention to other management concerns. Aggregate efficiency dropped 4.3% but is still 25% better than 1978 reference levels.

Electricity is a relatively large source of power, supplying 34% of total consumption. Where electrical loads are essentially constant, any change in production volumes has a large impact on overall operating efficiencies. Since two-thirds of plant electrical loads are used for refrigeration and material handling systems, and given the nation's highest prices and 12-month large ratchet-rate contract structures, load control continues to be the main focus of attention.

The balance of energy is supplied by fuel oil in the Maritime Provinces, and natural gas in British Columbia. Three percent of the total fuel comes from fish oil and other plant wastes.

Product quality, labour productivity, and safety and health far outpace the concern for energy efficiency. As for improvement potential, HVAC and refrigeration are the top items with process technologies at the bottom of the list. Barriers to improvement are shown in the general listing.

Grocery Products

Companies in this sector make or process a large number of different products such as coffee, pasta, soup, canned and frozen foods. Companies with extensive process heating, evaporation and/or product refrigeration often have energy intensities near 20,000 kJ/kg. However, the majority of companies in the survey report energy intensities in the 10,000 kJ/kg range with energy costs about 5% of total manufacturing expenses.

This group's energy efficiency improved 3.8% during 1989, which boosted the gain to 23.4% since 1985 and 32% since the original 1978 base year. Impressive gains have been reported each year. Interestingly, the pattern of concerns reported in this sector was more evenly balanced than shown in the aggregated table. This might be the result of more stable operating conditions and steady progress in energy management.

Companies in this group are rapidly installing the latest high-tech energy management controls, e.g. PLCs, and are reviewing their process technologies.

In the past ten years, the natural gas share has nearly doubled from 38 - 73% while heavy fuel has followed an opposite trend. Most fuel oil use now occurs only when natural gas service is interrupted.

The overall electricity share has changed little from 19 - 22% in recent years, even though several Quebec based companies report that it has been necessary to revert to fossil fuels. Hydro Quebec recently cancelled its Electric Boiler Incentive program because of low water levels. However, in some cases, they are paying customers to keep their electric boilers in standby condition.

Meat Packers

The meat processing industry continues to experience swings in operating efficiency, mostly because of varying production levels, changing government hygiene standards, company rationalizations and a slow rate of investment in new equipment. Recent performance has slowed or dropped as a result. Efficiency was down again by 1.3% in 1989. The greatest part of the overall 41.3% gain since the 1977 base year occurred before 1985 when significant plant improvements were made.

Meat packers have seen the largest proportional increase in electrical use in the past ten years. This share has gone from 18% to over 30% of the total mix because of added refrigeration equipment, conservation efforts directed towards fossil fuels, greater automation, etc.

The status of energy management now is relatively low because of the overriding concerns for profitability, competition with larger U.S. companies and labour productivity. Participating companies report directing most of their efforts to "housekeeping" actions.

Poultry and Egg Processors

This sector includes a mix of poultry and egg processors, each with different energy requirements. For example, energy intensity for the egg and egg product processors averages about 4500 kJ//kg while the poultry processors' average is 2630 kJ/kg of output.

Based on a smaller sampling of participants than previous years, energy utilization declined by 7% in 1989. Business volume was virtually the same as in 1988. However, this sector is the highest user of electricity at 44% of the total mix, and performance is therefore very susceptible to individual production swings.

In this group, concerns were generally rated higher than in other groups. This could be an indication of the "hands-on" style of management in these companies and the thin profit margins caused by tough competition. It is a reflection of such pressures which has led to the lowering of the overall efficiency gain to 8.2% since 1985. While housekeeping activities have provided the bulk of efficiency gains to date, some HVAC, lighting, and a few major heat pump installations have helped.

Plant energy use appears level but delivery truck fuel efficiency is still receiving attention. Nearly all the re-

spondents gave energy management a higher priority than in the past.

Electricity is the dominant source of energy in this industry. Some Quebec plants are totally electric-powered. Elsewhere, plants get about one-half of their energy from electricity.

Sugar Refineries

During 1988, performance improved by an impressive 8.4%. This greater than usual increase (normally averaging 4.3% per year) raises operating efficiency to 16.1% over the 1985 Base Year level and 44.4% over 1975 operating conditions. Industry-wide rationalization, follow-through on energy audits, investment in new equipment and closer attention to energy consumption have paid dividends.

Aggregated energy intensity for this homogeneous product now is down to about 3500 kJ/kg of output. With approximately 95% of total energy coming from fossil fuels, mechanical vapour recompression and greater heat recovery hold significant energy saving possibilities. Some cogeneration is now done to help lower the electrical share to 5%. Raw sugar melting and slurry evaporation remain the largest part of plant steam loads.

Wineries

Canadian wineries have only recently begun reporting results. In 1989, the sector's energy needs were met principally by natural gas (58.6%) and electricity (29.6%). Compared to 1988, performance improved just under 1%. This sector has one of the lowest energy intensity levels with costs less than 1% of the value of shipments.

The sector's management concerns follow the general pattern for the industry. The potential attached to improved process technology was the lowest in all the groups, whereas refrigeration improvements apparently have the highest potential. In this industry, managers must live with their operation and can't afford to overlook the smallest detail.

Future Performance Outlook

The 31% improvement goal set for 1990 is achievable if normal performance returns to the 2.7% per year average rate of gain. However, this is doubtful in view of declining profit margins, investment trends and capacity utilization rates. On the positive side, free trade is pushing companies to take a hard look at productivity problems.

The beverage sector is faced with the most acute problem. Its overall capacity utilization level of 61% is close to the low point of 58% experienced in the 1982-83 recession. The food sector's 1981 peak capacity utilization level of 84% has now declined to 79% which is also close to the 1983 low point. Meat plants in particular are affected by overcapacity while fish processing is suffering from a shortage of stock.

Capital spending is slowing from the high levels experienced in the 1987-88 boom period. Spending on new machinery and equipment increased 15% in 1987, 16% in 1988, and is now optimistically forecast at 12.5% for 1989 according to the latest Statistics Canada spending intentions survey. Less new equipment is being purchased and efficiency performance may suffer under tighter maintenance budgets that are not keeping up with the rate of inflation.

Table I

Food and Beverage Industry

Group Energy Consumption, Performance, Costs, Savings

Sector	Base Year	Consumption Terajoules	1989 Eff. %	Total Eff. %	Estimated Cost ($,000)	Annual Savings ($,000)
Bakeries	1979	1,054	3.78	20.77	8,890	184
Biscuits	1979	1,067	−2.17	11.55	9,094	105
Brewers	1976	8,305	−5.90	3.35	68,555	172
Confectioneries	1981	1,426	−8.49	24.72	12,548	396
Distillers	1977	4,826	7.26	30.24	26,531	687
Fisheries	1978	1,346	−4.33	25.29	12,453	281
Grocery Products	1978	4,120	3.82	32.11	30,662	863
Meat Council	1978	3,740	−1.30	41.34	32,012	1,150
Poultry and Egg	1982	842	−7.01	3.53	9,800	49
Food Processors	1976	5,464	0.81	23.28	39,433	706
Sugar Refineries	1975	2,301	8.39	44.41	11,667	370
Wineries	1988	84	0.43	0.43	789	—
Totals		34,877	−1.69	27.01	262,439	4,967

Table II

Food and Beverage Industry
Energy Use and Efficiency

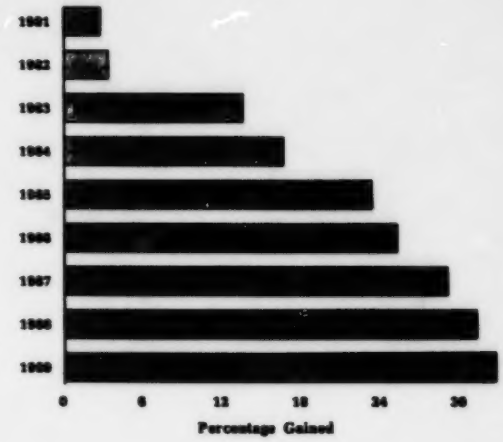
Type	Units	Terajoules	Distribution % 1989	1985	1979
Natural Gas	596,324,716 m^3	22,183	63.6	69.7	44.9
Electricity	2,120,801 MWh	7,635	21.9	18.6	16.9
Liquid Petroleum Products:					
#2 Fuel Oil	46,205 kL	1,802	5.1	1.2	2.7
#5, 6 Fuel Oil	71,455 kL	2,851	8.2	9.4	14.5
Diesel & Gasoline	2,902 kL	115	0.3	0.2	0.4
Steam		121	0.3	0.3	.6
Others Fuels:					
Propane, LPG	6,036 kL	160	0.4	0.2	0.2
Miscellaneous	—	10	—	0.4	0.6
1989 Total Consumption		34,877			
1985 Base Year Equivalent Consumption		36,902 Terajoules			

Efficiency Improvement 1977 to 1985		21.53%
	in 1986	1.24%
	in 1987	3.15%
	in 1988	2.78%
	in 1989	−1.69%
Total Improvement		27.01%

General Manufacturing

Energy Conservation Task Force

Bent K. Larsen
Chairman



The energy efficiency survey is based on a diverse group of manufacturing companies that are members of The Canadian Manufacturers' Association (CMA). The participants have been segregated into categories according to their type of manufacturing technology and/or energy intensities. Though the sample is relatively small, the high quality and steady supply of broadly based information provides a good picture of general manufacturing conditions. Three-quarters of the participants spend more than one million dollars per year for energy and routinely practice effective energy management.

General Performance and Business Conditions

Aggregated energy efficiency slipped 0.4% during 1989, which lowered the overall gain to 8.3% since 1985 and 31.6% since the original 1980 reference year. The 1989 result is the first downturn recorded since monitoring began in 1979.

The surveyed group's estimated total cost of fuel and electricity amounted to nearly $150 million during 1989. The average energy cost of $7.50/gigajoule (GJ) was up sharply from $6.56/GJ in 1988, mainly because of higher electricity costs in Ontario.

Consolidated energy shares for the group remained virtually the same as 1988 at 33.6% for electricity, 50.7% for natural gas, and 8.1% for petroleum products. Even with the slight decline in energy efficiency, additional cost savings were realized because of the higher energy prices and costs.

Energy performance suffered because of deteriorating business conditions through 1989 which caused a slowdown in production growth and a more conservative approach to investment spending. The bank prime interest rate rose to 13.28%, the Canadian dollar was pushed up to 84 cents U.S., corporate profits (before taxes) shrank 14.6% and capacity utilization declined from 90.8 - 89.4%. While the strong capital investment momentum in the entire manufacturing industry rose 8% during 1989, not all sectors, such as metal fabricating, enjoyed the same trend. Here, investment dropped 11% and is forecast to drop even more in 1990.

Continued soft energy prices did not stimulate increased performance during 1989 as in previous years. Shown in the accompanying graph, the motivation for improving energy efficiency is greatest when energy prices rise faster than product selling prices. This situation is expected to occur again in 1990 thanks largely to the impact of the proposed 7% Goods and Services Tax (GST).

The indices also show how electricity prices have steadily risen in comparison with deregulated natural gas prices, and how the steep drop in oil prices in 1985 helped lower the overall energy costs to industry. However, it is expected that oil prices will escalate again in 1990.

Manufacturers will have to intensify their Total Quality Control efforts even more to help offset this effect on increased energy prices. Because electricity is the most significant cost component, given its higher prices and large share of the total consumption, manufacturers should cooperate as much as possible with their local utilities' Demand-Side Management activities.

Total Quality Control

The surveyed companies were asked to rank the importance of selected components of their Total Quality Control programs to determine the relative importance of energy management. The selected items were categorized as: general concerns; future sources of improvement; and barriers to improvement.

Though the list is short and contains a mix of general (business) and specific (technical) issues, it does provide a valuable overview of where the manufacturing industry is devoting its attention. Government policy makers would do well to study these concerns and priorities.

Status of Energy Management

General Concerns		Energy Improvement Sources		Barriers	
Product Quality	88.3	Monitoring & Control	64.4	Economic Payback	76.5
Safety & Health	84.1	Process Technology	62.5	Other Priorities	56.5
Profit Improvement	82.9	Housekeeping & Maint.	58.7	Staff Limitations	56.8
Labour Productivity	80.6	Electrical Systems	52.5	Uncertain Business	52.9
Plant Equipment	68.2	Combustion Systems	51.5	Technical Constraints	52.3
Pollution	67.6	Other Utilities	50.6	Impact on Occupants	51.7
Energy Efficiency	62.9	Buildings	50.6	Government Incentives	51.1
Raw Material Prices	61.1	Waste Heat Recovery	50.0	Detailed Information	41.1
Training	55.3	HVAC	41.8	Impact on Product	37.6
R&D	37.6	Materials Handling	33.3	General Awareness	28.8

Management must strategically proportion time and resources according to the needs of the company. The above general concerns show a distinct time-related bias where daily attention to product quality cannot be relaxed and long term activities, such as R&D and training, get only the residual attention. Relative costs, type of products, etc. undoubtedly also had an impact on ratings.

However, the mid-point rating given to energy efficiency is significant considering the importance of such factors as maintenance of product quality, safety and health considerations, and profits. Labour productivity continues to be a top concern because of the intense competition in today's free trade environment.

Recognition of the close linkage between energy use and control of the environment might also be inferred from the given standings. Indeed, many companies have lumped these two activities together for joint improvement.

Improved monitoring and controls are seen as having the most immediate cost saving benefit and do not require large capital investment. Many of the surveyed companies are very labour intensive and use mature technologies that cannot be changed.

The highest-ranked barrier to improved performance was unacceptable financial returns. This was followed by uncertain business conditions, indicating management is becoming more cautious in their investment plans in view of rising interest rates and slower production. The lack of strong financial incentives and/or a supportive tax structure was also not helpful.

Group Trends

Rubber Products

Participation in this group has shrunk as a result of tough business competition, thin profits, and continuing rationalizations. Energy performance has also declined 2.5% during the year. Aggregate improvement has slid to 31.5% over 1972. However, while several old plants are being shut down, smaller new specialty plants are being built to serve niche markets.

Whereas other groups registered pronounced differences in plant management concerns and specialized sources of future improvement, this group rated everything at a higher level, suggesting their problems are more broadly based and much more acute.

The electricity share of total energy consumption has risen about 2% in the past six years to 35%.

Natural gas provides 29% of the mix while nearly 35% comes from heavy oil.

Specialty Chemical and High Intensity Products

The companies in this group make a variety of energy-intensive products including sodium chlorate, fibreglass insulation, and specialty chemicals. Consistent tracking of participants' annual performances show efficiency has risen 5.4% during 1989. Overall performance is nearly 30% better than in 1978, helped considerably by one company's major process revision and by-product hydrogen burning operation last year.

Labour productivity, safety and health and product quality outranked energy concerns in this group, putting them almost on the same level as attention paid to overall profit improvement. The particular sources of future energy improvement and perceived barriers all varied widely because of the different processes and markets involved. The very high level of energy use "awareness" in these companies suggests that monitoring and general performance is not a problem.

Foundries, Forging, and Heavy Metal Operations

Companies reporting in this highly energy-intensive category had mixed efficiency gains resulting in a marginal improvement of only 0.2%. This leaves the aggregated improvement at 6.1% since 1985 and 12.6% since the original 1981 reference year.

This sector is more concerned about pollution, rising raw material costs, energy prices and process improvements than others in the survey. This anxiety is also shown in a higher than average effort to improve monitoring and control of combustion systems and a higher level of frustration shown in overcoming technical difficulties and economic obstacles to improved efficiency.

However, innovative solutions are being introduced to solve some problems. For example, Environmelt Ltd. in Stoney Creek, Ontario, has recently started up a new foundry process where graphite is injected into the natural gas fuel to add carbon more effectively into the iron melt. This "cokeless cupola" process, it is claimed, creates a pollution-free operation and results in significant increases in productivity.

Other efforts to change technologies, e.g., mechanical attrition and thermal reclamation of casting sands, a shift to induction melting in the foundry sector, oxygen enriched furnaces in forging companies, more heat reclamation in most sectors, etc. have also helped to contain rising energy costs.

However, the share of expensive electricity continues to rise slowly and is now 35% of the overall energy used. The natural gas share has remained level at 48% while consumption of coal and wastes at 12% and fuel oil at 5% have slowly decreased.

Cheap and plentiful natural gas remains the best fuel where continuous heating is required while induction melting offers advantages in operations that are intermittent. Companies are monitoring electrical demand more closely as this cost component is rising rapidly because of broader application of Time-Of-Use (TOU) rate structures.

The two key factors that mitigate against large investment in energy improvements in the mature metals industry are technological obsolescence and production decline. The foundry business, for example, has seen a general 2% volume decline from 1975 to 1985 and twice this rate in the past four years. Increased foreign competition, material substitutions, design changes, etc. have exacerbated the problem in all sectors.

Light Manufacturing

These companies have had steady energy efficiency improvements of 3.4% in 1989 and 4% in 1988. Aggregate gains have reached 13.1% since 1985. In this group, electricty has always provided 25% of the power and natural gas 70%.

The steady energy performance gains reflect the intense efforts at Total Quality Control. Companies operating in this labour-intensive industry are very much exposed to international competition and must substantially improve to survive. Product quality, labour productivity and training had the highest plant management concern ratings. In the past the efficiency emphasis was directed to product and plant rationalization. Aggressive companies like Bombardier Inc. in Montreal have invested heavily in new product development and have expanded into world markets.

Energy efficiency outranked pollution on the rating scale probably because energy improvements are still seen as having a direct economic return on investment. In a recent CMA general survey, only 11% of the respondents ranked the environment as the issue of first or second importance for federal government action.

Regarding future sources of energy improvement, even though there were considerable differences in this group, companies are now placing more emphasis on plant utilities than on processes and more effort on people related solutions than on capital expenditure solutions, i.e. training and maintenance rather than heat recovery for energy improvements. It is expected this trend will continue into the foreseeable future.

Figure I

General Manufacturing
Energy Costs vs Value of Shipments
Manufacturing Sector

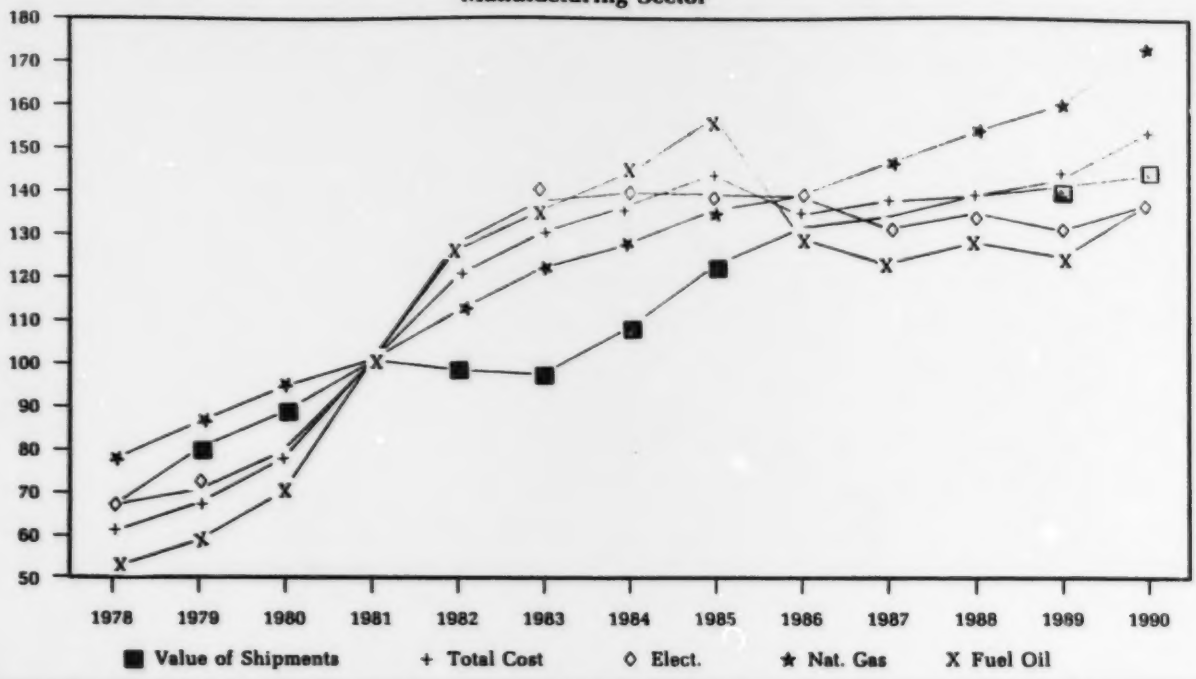


Table I

General Manufacturing Industry
Energy Use

Type	Units	Gigajoules (10^9)	Percent Distribution 1989	1987	1985
Natural Gas	284,363,290 m^3	10,578,319	50.7	51.7	60.2
Electricity	1,947,853 MWh	7,012,272	33.6	37.6	28.1
Liquid Petroleum Products:					
#2 Oil	6,778,735 L	264,370	1.3	0.2	1.2
#6 Oil	32,376,378 L	1,265,700	6.0	8.8	9.6
Diesel	2,659,878 L	106,129	0.5	0.6	0.4
Gasoline	1,805,591 L	65,362	0.3	0.5	0.1
Other Fuels:					
Propane	8,253,324 L	219,538	1.0	0.3	0.3
Steam	n/a	36,400	0.2	0.2	—
Others	n/a	1,288,950	6.2	0.1	0.1
Totals		20,837,031			

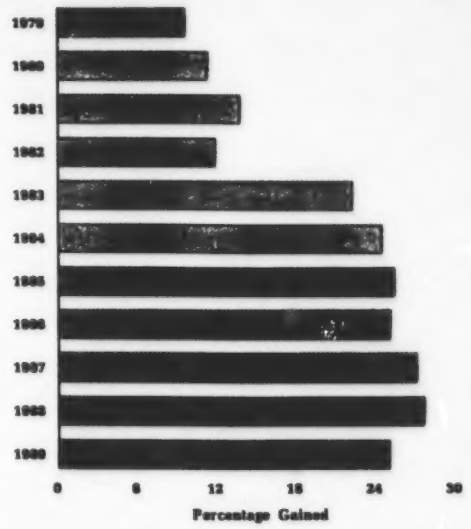
1985 Base Year Equivalent Consumption: 22,719,031 Gigajoules

Energy Efficiency Gain between 1981 and 1985:		23.4%
	1986:	1.9%
	1987:	3.8%
	1988:	3.0%
	1989:	–0.4%
Total Energy Performance Improvement:		31.7%

Industrial Minerals Industry

Energy Conservation Task Force

John M. Lind
Chairman



Sector Description

There are nine sectors in the Industrial Minerals group that mine, process and manufacture a variety of non-metallic products for use in construction and other manufacturing industries. The value of shipments from this group amounted to $7.6 billion in 1989.

The energy consumption and trends shown in this survey represent about 85% of the total industry performance. Approximately 90% of the gray cement producers, nearly three-quarters of the ceramics industries, abrasives, clay brick and tile, glass and refractory producers are included. Half of the lime producers and about 10% of the diverse concrete product manufacturers usually participate. The reporting population in this voluntary program is slightly down from previous years due to added business pressures. However, the group's total representation went up because of the inclusion of one large integrated company in the miscellaneous minerals sector.

Improving energy efficiency is an important goal throughout this industry because of the high energy intensities and large cost budgets. For example, the lime sector spends 35% of its manufacturing expense on energy, the cement sector allocates 25%, while the clay products, abrasives, glass and refractory industries operate in the 10 - 20% range. Continuous efforts are being made to reduce these costs. Higher operating efficiencies are also seen as the most practical and economic means of reducing the emission of "greenhouse" gases.

General Performance and Conditions

While the cement manufacturers reported no change in performance in 1989, four sectors showed gains and four had lower efficiencies. The aggregate result, as shown in Tables 2 and 3, was 2% lower for the year. This leaves the operating efficiency at nearly the same level as the 1985 reference year, but 25.4% better than the original 1975 base year energy intensities.

More importantly, estimated total energy cost would have been $176 million higher without the reported overall efficiency gains.

There are no apparent common business or technical reasons for the efficiency decline. Those sectors affected by a slowdown in construction markets, i.e. cement, concrete products, clay brick, and to some extent asbestos and glass, had mixed performances. Companies selling products to the steel and automotive markets also had opposing results. In the dominant cement industry, which accounts for over half the group's consumption, efficiency was at the same level as 1988 in spite of a 4% decline in production. The large glass industry also saw a decline in output and a subsequent loss of operating efficiency. Total investment in new construction and equipment, after adjustments for inflation, was at the same level as 1988. However, more went into new capital equipment (8%) and less into maintenance (– 2.3%).

This year, members of the group were asked to rank the priority of selected items impacting on energy efficiency, the most likely sources of improvements, and some of the barriers that will affect future performance. While the list is not exhaustive, it nevertheless paints a good picture of current operating conditions throughout the industry. This list is presented below.

Status of Energy Management

Plant Priorities		Improvement Sources		Barriers	
Safety & Health	90.0	Process Technology	78.8	Economic Payback	76.2
Product Quality	87.8	Combustion Systems	75.2	Business Conditions	73.1
Profit Improvement	87.2	Electrical Systems	71.3	Lack of Incentives	67.7
Pollution Problems	81.7	Monitoring & Control	67.0	Technical Difficulties	56.9
Labour Productivity	78.3	Maint. Procedures	54.0	Other Priorities	51.7
Energy Efficiency	76.1	Waste Heat Recovery	49.4	Staff Capabilities	50.0
Plant Reliability	71.7	Materials Handling	45.3	Impact on Product	49.2
General Cost Control	71.1	Buildings	36.7	Analyzed Opportunities	37.5
Training	58.9	Air Comp. Systems	36.0	Impact on Personnel	34.2
R&D	44.4	HVAC, Refrigeration	14.7	Awareness	33.1

The high priority given to energy efficiency suggests the flat performance in 1989 is only a temporary setback. Companies are planning an increase in energy conservation efforts because of growing emphasis on environmental controls, energy costs (especially electricity) that are escalating faster than normal and declining profit margins.

It is worth noting that in 1991, energy prices will be pushed up 7% more by the Goods and Services Tax.

There is a strong consensus that continued energy improvements will come mainly from improvements in process technologies, combustion systems, electrical systems, monitoring and controls, maintenance (housekeeping) techniques, and further recovery of waste heat. Though the basic technologies used throughout this industry are very mature, there is room for improvement in existing process equipment and production techniques.

The highest-ranked barrier to improved performance was unacceptable financial returns. This was followed by uncertain business conditions, indicating management now is more cautious in investment plans because of rising interest rates and slower production. The lack of strong financial incentives and/or a supportive tax structure was also considered a barrier.

Many retrofit projects are not implemented because of the enormous technical difficulties involved and built-in plant and operating constraints. Companies' firm commitment to a lean staffing mode may explain the slow progress, even while there is no shortage of improvement ideas.

Energy Use Trends

The patterns of consumption and substitution of fuels have been mixed because of technical constraints in each sector, plant locations, relative costs, etc. Current patterns and some of the more significant changes have been noted below. The group's overall trend is shown in Table 2.

These energy substitutions have had a noticeable impact on allocation of energy budgets. While the group's proportion of electricity use has been only 2% since 1979, its share of total cost has risen 15%. At current prices, this translates into about $54 million being redirected to electricity. This situation now is a major concern to companies in electricity-intensive sectors, particularly the abrasives and refractory manufacturing operations where electrical costs are regularly compared to those of foreign competitors.

Since 1979, there has been only a 6% share reduction in natural gas use. However, the large drop in deregulated prices has resulted in a saving of $37 million among participating companies. Nevertheless, natural gas is still the dominant fuel in the industrial minerals industry.

Driven by government substitution incentive programs and concerns about availability, the decline in fuel oil consumption proceeded faster than falling prices. Between 1979 and 1988, the fuel oil share dropped from 27% to 8% of total energy while the proportion of total cost declined from 28% to 11%. In so doing, some $41 million was trimmed from this category in overall energy budgets. The slow rate of decline in the fuel oil share now appears to signal that a new economic balance point has been reached.

Coal has had a major impact on reducing the consumption of fuel oil as well as a minor effect on natural gas. During the 1979 to 1988 period, consumption of coal has more than doubled from 16% to 36%, but its percentage of total energy cost has risen only from 6.7% to 10.8% in the surveyed companies. As a result, an additional $13 million has been shifted to coal.

It is difficult to generalize on the impact of capital spending on energy efficiency because of the vast difference in capital and energy intensities, rate of spending, etc., in the various sectors. However, it is surmised the impact of annual spending on new machinery, growing from $193 million in 1985 to $359 million in 1988, has helped raise production capacities far more than energy efficiencies. Early indications of slower future capital spending and the prospect of lower capacity utilization rates does not appear supportive of continued energy efficiency improvement.

Sector Reports

Abrasives

Efficiency increased because of higher capacity utilization and minor changes in product mix. It has also been possible to revise some furnace operations to reduce heat losses and provide recovery of waste heat to preheat raw materials.

The energy intensity of silicon carbide production varies between 12,000 and 14,000 megajoules (MJ) per tonne of product, depending on the size and configuration of the donut shaped resistance "furnace" used in this process.

About 88% of total energy is supplied by electricity. The remaining 12% comes from natural gas used for emission cleanup. Heat captured from the raw material coke does not enter into efficiency calculations.

Raw aluminum oxide is made by fusing chemically purified alumina with fluxing agents and other admixtures in conventional electric arc furnaces. The electrical intensity of this process is about 10,000 MJ per tonne. Studies are now being conducted into the arcing stability of the carbon anodes as well as further optimization of the fluxing current.

Asbestos

Asbestos mining and refining is a moderately energy intensive process amounting to 6500 MJ/tonne of product. The British Columbian company is totally dependent on distilled fuel oil for its energy needs, including generation of electricity for the mill and town site. The Quebec companies obtain about 35% of their energy from electricity, 42% from residual fuel oil and 23% from other refined petroleum products used for vehicles and other miscellaneous purposes. Energy costs still amount to about 20% of the total manufacturing expense.

After several years of declining markets and business rationalization, total production output has stabilized. The group's performance dropped somewhat because one Quebec company was in the final stages of an expansion project. Investment in new construction and machinery and equipment in 1989 was up 10.5% over the 1988 expense of $101 million but is forecast to fall back to the 1988 level next year.

Cement Manufacturing

Increased efficiency in some dry process plants was completely offset by reduced performances elsewhere because of a 4.1% cutback in production.

Dry plants (without preheaters) managed to reduce energy intensities from 4620 to 4567 MJ/tonne. In dry plants (with preheaters), intensities went up from 4598 to 4697 MJ/tonne. Wet plant intensities rose from 5777 to 6132 MJ/tonne because of a large drop in capacity utilization. As a result, overall performance is nearly the same as recorded in 1985, but 23.8% better than 1974 base year levels.

Based on the $197 million estimated cost of fuel and electricity, the level of annual savings amounts to $61 million per year in the surveyed companies.

While significant fuel shifting took place in 1989 from natural gas to coke, the share of electricity and fuel oil remained much the same. Since 1985, the natural gas share has steadily dropped from 29% to 24.8% of total energy consumption. The coal share remains at 45.6%, but coke usage has increased from less than 10% to 14.7%. Electricity remains at 11.6% of the total while the fuel oil proportion is now down to 3.2%.

Clay Brick, Tile, and Clay Products

Group energy efficiency was down marginally because of an industry wide 13.7% decline in capacity utilization. However, some companies reported productivity gains due to fewer equipment problems and a general effort to become more competitive in the free trade environment. The majority of the companies surveyed forecast that efficiencies will rise next year for a variety of technical and business reasons.

The energy intensity of clay brick production varies between 3500 and 4000 MJ/tonne (1.8 tonnes/1000 equivalent units) depending on the properties of raw materials used. The energy intensity of short run clay tile producers is nearly three times this amount. Energy costs often compose up to 25% of total manufacturing expenses.

The greatest amount of conservation effort has gone into furnace design, replacement and control of burners, heat recovery, and production scheduling. Electrical efficiencies are still commanding attention because of the variable demand and, now with lower production levels, the declining load factors.

Throughout the surveyed group, natural gas provides nearly 93% of total energy while electricity supplies most of the remainder.

Little propane and fuel oil are reported for use in plant vehicles. The cost of electricity amounts to one-quarter that of natural gas.

Concrete Products

The concrete products sector is a diverse manufacturing group that makes concrete blocks, sewer casings, precast slabs, and a host of miscellaneous products for the construction industry. Even though the energy-intensity of the products is relatively low, the reported high priority given to energy efficiency and annual energy expense ranging up to $750,000 in the surveyed companies suggests that energy management is a primary concern. Energy costs average 5 - 8% of total manufacturing expense in this sector.

The 2.7% efficiency gain reported in 1989 was due primarily to a 4.7% rise in production. The most common product, concrete block, still requires 350 to 500 MJ per tonne (10 to 12 MJ/equivalent unit) of output. Considerable variation exists because of the type of curing systems used, degree of dryness tolerated, strength of admixtures, etc.

Nearly 70% of the energy share is provided by natural gas and less than 6% from electricity. All the remainder is diesel fuel used by yard vehicles.

Glass

The companies in this group operate 19 large continuous glass making plants which produce about 90% of the glass containers, flat glass and fibre insulation used in Canada. Glass making is an energy-intensive operation requiring about 4.7 gigajoules per tonne for the melting operations alone.

Annual efficiency has varied since 1985 but is still nearly 35% better than 1974 base year operating conditions. Growing international competition, introduction of the government's Container Act policies, merger of two of the largest container companies, increased recycling of used glass (cullet), and reduced rate of investment leading up to 1989 have affected current operating efficiencies.

Since monitoring began in 1978, the share of electricity has doubled from its 9.4% level. Some companies have added electric "booster" heaters to their furnaces to increase production. Over the same period the share of natural gas has declined from 84% to just under 77%. Use of other fuels has remained about the same.

Lime

Companies in this group make various grades of lime and cement, as well as dolomite products for fluxing, refractory and chemical use. Lime, made by calcifying quarried limestone at 2650° F in rotary kilns, has an energy intensity of about 6300 MJ/tonne. Energy accounts for nearly 40% of total manufacturing expense, making it one of the most important elements of plant cost.

The large gain in operating efficiency in 1989 is the result of several technical improvements and management's intensive effort to raise overall productivity. Kiln operation continues to be the focus of attention because nearly 50% of the heat content of the fuel (2800 BTU/100 pounds of raw material feed) exits the stack at about 800° F.

While some lime kilns can be fired with coal or coke, natural gas is the preferred fuel when high product purity is essential. Since monitoring began, the electrical share has remained at 6% but the natural gas share has varied between 50 - 65% depending on the mix of reporting companies and competitive price of coal and coke. Use of fuel oil has been reduced from 32% to almost nil since 1979.

Miscellaneous Minerals

This dissimilar group of companies produces a variety of products such as: matte (impure fused materials consisting of metal sulphides), silica sand and nepheline for glass making, raw crushed limestone and gypsum products, roofing granules and sodium sulphate. Many of these batch processes require extensive crushing and pulverizing, milling, refinement, drying and grading.

The processes are heavily dependent on electricity (57% in the 1989), moderate users of natural gas (35%) for drying, and the remainder is composed of back-up and vehicle fuel oil.

The greatest number of electrical service interruptions and power quality problems was reported by this sector. This may be due to the remote locations of most of the companies, which means utility distribution systems are showing increasing signs of overload. The growing number of outages affects plant operating efficiencies negatively.

Refractories

Manufacture of fired refractory products is akin to clay brick production except that energy intensities are much higher-in the 6500 MJ/tonne range-and costs usually amount to 40% of the manufacturing expenses.

It is difficult to aggregate the data yet protect the confidentiality of individual information because of the great diversity of products, difference in raw materials, and curing temperatures. No identifiable reasons are evident for the decline in energy efficiency.

In general, electricity still provides about 16% of total energy with the balance from either natural gas or heavy fuel oil, depending on the location of the company. Combustion systems, materials handling improvements, and process technology are the key areas that dictate energy management attention.

Table II

Industrial Minerals Industry
Energy Consumption and Cost

Sector	Base Year	Consumption Terajoules	1989 Eff. %	Total Eff. %	1990 Target %	Estimated Cost ($,000)	Annual Savings ($,000)
Abrasives	1982	3,198	4.02	14.47	20	37,465	6,336
Asbestos	1979	4,747	– 6.17	9.69	10	36,323	3,895
Cement	1974	52,886	0.00	23.79	40	197,511	61,651
Clay Brick	1978	3,450	– 1.54	26.38	40	15,843	5,677
Concrete Products	1979	611	2.73	18.67	20	3,429	787
Glass	1974	18,423	– 1.03	34.94	50	113,523	60,977
Lime	1979	6,008	5.00	22.86	25	36,557	10,832
Miscellaneous Min.	1977	6,652	0.57	12.37	15	71,337	10,067
Refractories	1975	978	– 4.60	5.87	15	5,198	324
Totals		96,956	– 1.96	25.74	35	517,189	179,862

Table III

Industrial Minerals Industry
Energy Use and Efficiency

Type	Units	Terajoules	Distribution % 1989	1985	1979
Natural Gas	1,034,937,773 m^3	37,521	38.7	42.6	44.9
Electricity	5,058,648 MWh	18,207	18.8	15.6	13.9
Liquid Petroleum Products:					
#2 Fuel Oil	14,955 kL	574	0.6	1.2	2.7
#6 Fuel Oil	93,754 kL	3,817	3.9	5.1	14.5
Diesel & Gas	56,184 kL	2,227	2.3	2.2	7.4
Coal & Coke	12,203,600 Tonnes	33,437	34.5	32.4	15.8
Other Fuels:					
Propane, LPG	10,801 kL	284	0.3	0.2	0.2
Wastes	—	885	0.9	0.7	0.6
1989 Total Consumption		96,956			

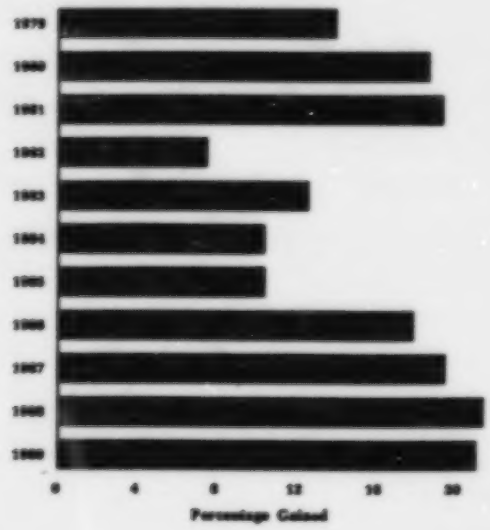
1985 Base Year Equivalent Consumption = 93,349 Terajoules

Efficiency Improvement	to 1985	= 25.4%
	in 1986	= – 0.3%
	in 1987	= 2.0%
	in 1988	= 0.6%
	in 1989	= – 1.9%
	Total Improvement	= 25.8%

Machinery Industry

Energy Conservation Task Force

Frank A. Hlohovsky
Chairman



Task Force Description

The machinery industry companies represented in this section of the report are member firms of the Machinery and Equipment Manufacturers' Association of Canada (MEMAC). MEMAC members are Canadian manufacturers of a wide range of machinery and equipment used in the resource, energy and process industries – from mining, pulp, paper and printing equipment to cranes, conveyors, gears, pumps and valves. The majority of firms are of the low energy intensity type, generally in fabrication and assembly operations. However, they supply the most energy intensive industries (mining, pulp, paper and petroleum) and have a significant impact on the quantity of energy consumed per unit of production or activity.

The survey covered approximately 100 firms. The majority are located in Ontario and Quebec. The participation level, however, was a disappointing 25%.

General Performance and Progress

In 1989, participating MEMAC members achieved a 1.6% net improvement in energy consumption relative to 1985. Compared to the original base year, the improvement is 23.1%.

As in previous reports, the absolute value of improvement must be used with caution, particularly when using the base year. There has been a great deal of rationalization in the industry as well as a trend towards sub-contracting of higher energy intensity activity. It is considered that either or both of these factors have caused a distortion in the absolute improvement values. Member firms are fully committed to reducing the rate of energy consumption in their manufacturing activities and that is the most important factor.

Future Outlook and Concerns

Environmental concerns have contributed to a heightened awareness in all industries of technologies available for energy conservation. Two examples are improved efficiency electric motors and improvements in tribology. This awareness will be exploited to motivate the demand side, particularly the resource industries, to choose the most energy efficient machinery and equipment when undertaking capital investments or retrofits.

The industry will continue to participate in Ontario and Quebec government initiatives in energy management and promote Quebec and Ontario Hydro programs.

The MEMAC task force believes that the environment is an issue for the 1990's and that energy efficiency improvements will contribute not only to resolving problems for a cleaner environment but also to improving the industry's competitive position.

Table I

Machinery Industry
Energy Use and Efficiency

Type	Units	Gigajoules (10^9)	Distribution % 1989	1985
Natural Gas	8,427,137 m^3	313,488	52.5	44.3
Electricity	47,217,704 kWh	169,985	33.9	35.1
Liquid Petroleum Products:				
Distillate Oil	223,878 L	8,731	1.7	5.6
Diesel	8,365 L	326	0.1	0.1
Gasoline	98,397 L	3,562	0.7	0.6
LPG	167,952 L	4468	0.9	1.1
Other Fuels:				
Propane	31,616 L	857	0.2	0.3
1969 Total		501,417		

Mining and Metallurgy Industry

Energy Conservation Task Force

Paul B. Batten
Chairman

Task Force Description

The mining industry is the fourth largest industrial consumer of domestic energy in Canada. The entire industry consumed 266 petajoules (PJ) of energy in 1989 – 12.7% of the total industrial use and 3.3% of the total domestic demand.

The Mining and Metallurgy Energy Conservation Task Force was organized in 1975 and is operated under the auspices of the Mining Association of Canada (MAC). Participants include the major Canadian producers of basic metals and ores, uranium, potash, coal, synthetic oil and fertilizers. A number of energy-intensive processes are used including mining, milling, smelting, indurating and refining.

Sixteen major integrated companies participated in this survey. These companies operate a total of 37 sites in addition to the associated processing operations. Based on output figures and energy consumption data, it is estimated that 80% of the Canadian mining industry output, excluding asbestos mining and quarrying operations, is covered in this survey.

The task force continues to promote energy efficiency through technology transfer activities and by providing technical seminars and case study information to its members. Activities in 1989 included a special seminar on energy technologies at the Ortech International facilities in Mississauga and involvement in the Laurentian University seminar on Energy Efficient Technologies in the Mining and Metals Industry. Other activities include promotion of a new western branch in British Columbia and Alberta where over half the industry is located (11% of the industry is located in Saskatchewan, 13.5% in Ontario and 8.4% in Quebec).

Performance

The participating companies had an aggregate 3.6% improvement in energy intensity during 1989 which boosted the total gain to 19.6% since the consolidated 1973 reference year. With the strong recent performance and having already surpassed the 1990 performance goal of 15%, a revised target of 25% has been set.

Energy cost savings of $29 million were achieved during 1989, based on the gain in operating efficiencies and the estimated $1 billion in purchased cost of fuel and electricity. It is estimated the average cost of energy used was about $7.40/gigajoule (GJ) throughout the industry.

The mining industry's energy performance since 1978 is displayed in Figure 2 to demonstrate the impact of certain key operating and business factors on energy utilization. It shows that energy efficiency in this industry is mostly influenced by changes in capacity utilization, indirectly affected by changes in production and affected least of all by the amount of investment in new equipment and machinery. The impact of investment is low because of the time lag in (monitored) benefits from new equipment and the low percentage of designated investment used to reduce energy costs. In a special study by Statistics Canada it is estimated that less than 5% of total spending has an impact on energy efficiency whereas the general manufacturing industry is spending only 1% of its capital budgets on energy retrofits. Twice as much is

spent on environmental improvements as energy projects. The graph also shows that the energy efficiency trend is more stable than other related variables. Operating efficiencies, including energy utilization, often become the main focus of attention in a down cycle and are helped when the most inefficient mines are closed.

The relationship between energy utilization and capital investment is becoming an important consideration not only because of its impact on energy efficiency, but also its effects on environmental protection since these two subjects are very closely linked. This relationship is now being studied by government policymakers who have already opened discussions on this matter with task force representatives.

Capital investment in the mining industry fell again this year after reaching a peak in 1988, when profits were at their highest level in over a decade. Profits slipped 1% in the integrated sector, 47% in the "general" category, and 927% in the gold mining sector. Investment in new equipment fell 14% to $2.7 billion. Traditionally the mining sector spends 26% of its investment on new equipment while a greater portion (31%) is used for repairs and maintenance.

Capacity utilization (which Statistics Canada now weights to reflect the technological effects of capital investment), fell 3.5% during 1989. The gold mining sector was particularly affected.

In Canadian operations, open pit mining techniques are generally used three times more often than underground mining methods. Open pit operations, excluding smelting and refining activities, now use between 18 to 36 megajoules (MJ)/ tonne of output. For underground methods, energy usage amounts to 90 to 180 MJ/tonne depending on the product, location, age and a host of operating factors.

In large mine operating budgets [1], electricity accounts for 6%, fuel 2%, labour has the largest share at 41%, supplies amount to 21%, and 29% is allocated to depreciation, amortization, administration and other miscellaneous expenses.

Energy Use Patterns

Energy consumption by participating companies in 1989 amounted to 142,870 TJ, but with 8,121 TJ transfer and use of refinery off-gases and by-products, purchased energy amounted to 134,749 TJ. Figure 3 shows the general shift in energy shares since task force monitoring began in 1978. While the mix of energy sources reported has been affected somewhat by changes in the reporting population and the dynamics of sectoral production volumes, in general there has been slightly more growth in electricity use than shown. This trend has been evident from the individual company surveys.

Because electricity is the largest energy cost component, its use is closely monitored and efforts are being made to use it more effectively. In the article cited above, 29% of mine site electricity is used for ventilation, 11% for pumping liquids, 30% for compressing air, 12% for hoisting, and 18% for miscellaneous surface and underground services.

Within the mining sector, electricity distribution varies considerably, as shown from task force figures and a study [2] of more detailed consumptions.

Attention is currently being focused on specific areas where energy consumption is high.

In small mining operations, it has been estimated that energy comprises approximately 30% of total costs. Research into new furnace designs has been the subject of several ongoing projects jointly sponsored by government and industry. The new Lakeview TGS Electric Furnace Pilot Plant Facility, operated by Ontario Hydro Research Division, has been set up to study smelter configurations and fuel sources. One of the first projects scheduled is in conjunction with Falconbridge Ltd., to explore methods of overcoming metallic build-up inside furnaces as concentrated roasting heat is increased, an action that will reduce SO_2 emissions.

Other electrical saving techniques discussed at a recent Ontario Ministry of Energy/Canadian Committee on Electrotechnologies seminar included electrical peak shaving methods such as using a site's emergency standby generating equipment. Falconbridge's Onaping area Energy Monitoring Project, a complicated network linking five sites together, typifies the intense efforts at reducing electrical consumption.

Future Outlook

While 1989 was the third year of impressive gains in energy efficiency since 1985, it is generally acknowledged that the mining industry must accelerate introduction of new technologies to maintain its prominence in world markets. Too often, only the large well established companies are able to invest in R&D and technical improvements. Junior companies still tend to use relocated equipment and outdated processing technologies.

Promising new techniques are now being developed that could have widespread use. These include use of ultrasonics to weaken rock and ease blasting and ventilation requirements, further development of electric vehicles to minimize mine pollution and HVAC, television monitoring of separation tank surface bubble sizes and colours to provide on-line optimization of flocculation systems, etc. Other developments being tried include autoclave

[1] Mine Energy Usage, (Copper Cliff South Mine), Ed. Sirkka, Inco Limited, Symposia on Energy Efficient Technologies in the Mining and Metals Industry, 1989.

[2] Acres Consulting Services Ltd., "Ontario Industrial Energy Demand Study", Ontario Ministry of Energy, 1980.

oxidation techniques in the gold mining sector to oxidize sulphide ore and improve gold recovery.

As for future business prospects, little growth is expected in the use of common minerals because of shifting public attitudes. Increased recycling, reusing and recovering reduce demand for basic materials. Following the oil shocks of the 1970s and 1980s, a thriving industry of new synthetic materials developed, particularly in the U.S. and Japan. This trend to synthetics is expected to continue. The Canadian mining industry will have to respond to these trends with greater efficiencies, as ore bodies become less rich and more remote. The imposition of tough new environmental standards will add to the cost of doing business.

In spite of the forecast economic turndown in 1990, the task force's performance goal of 25% total improvement can be achieved. This should happen not only for technological reasons, but also because of the shutdown of marginal operations and intense efforts at controlling operating costs.

Figure II

Mining and Metallurgy Industry
Historical Energy Distribution

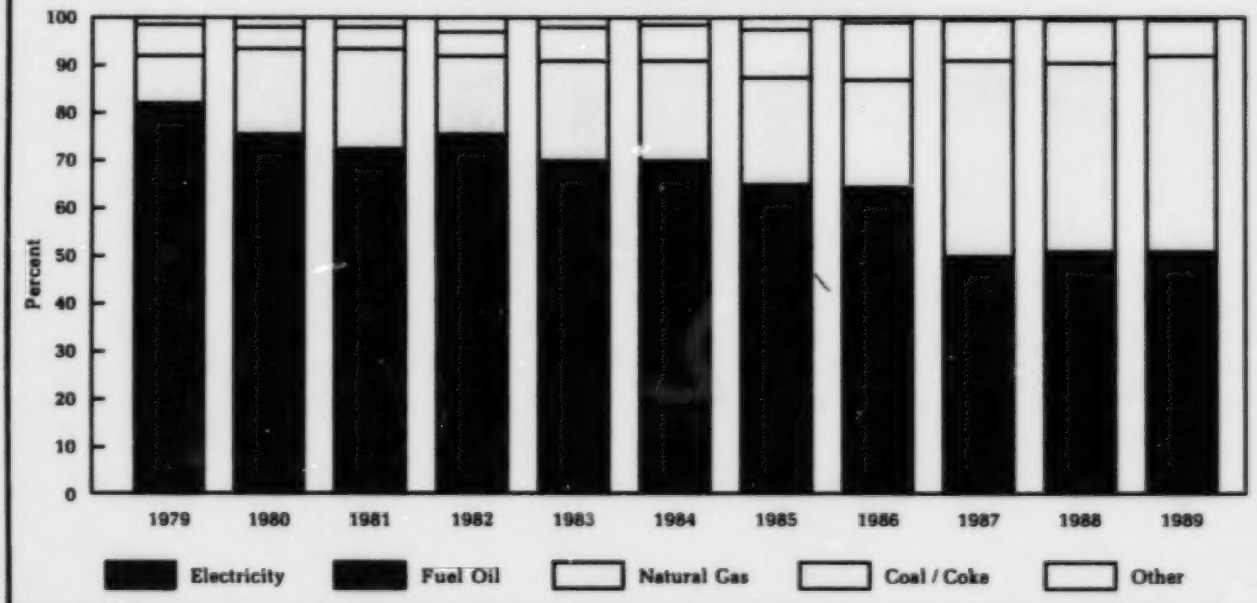


Table III

Mining and Metallurgy Industry
Energy Efficiency Improvement

Current year (1989) total energy inputs		164,290 terajoules
Base year (1985) equivalent energy inputs		181,918 terajoules
Adjustments (1985-1989)		626 terajoules
Net Improvement	= 10.6%	
Efficiency gain 1973 - 1985	9.6	
1986	-3.3	
1987	6.0	
1988	3.7	
1989	3.6	
Total gain 1973 - 1989	19.6%	

Figure I

Mining and Metallurgy Industry
Energy Performance
Versus Main Operating Factors

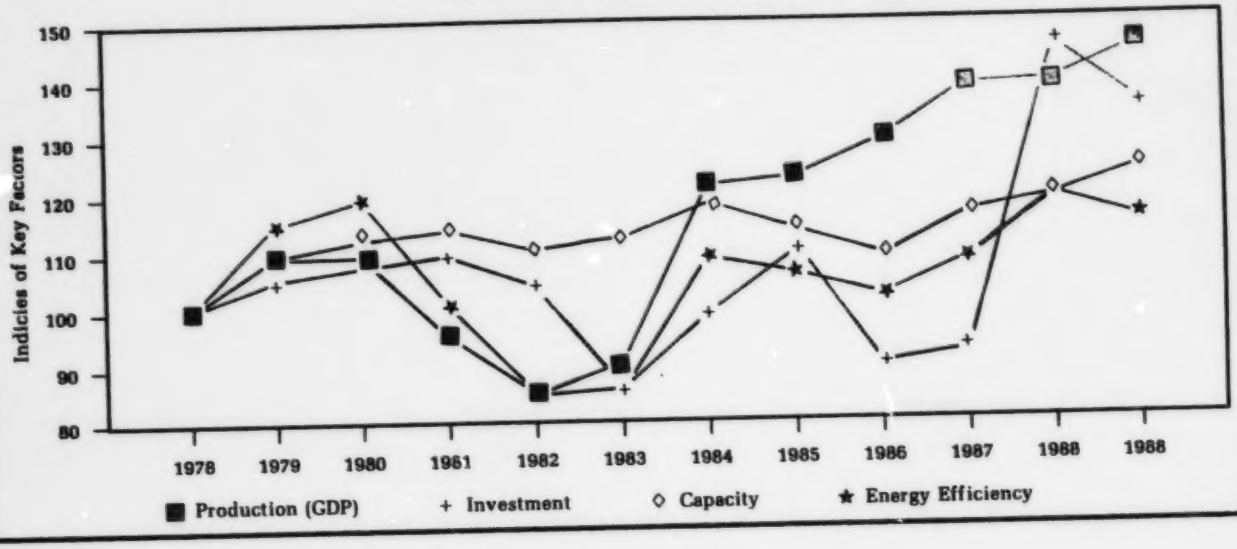


Table IV

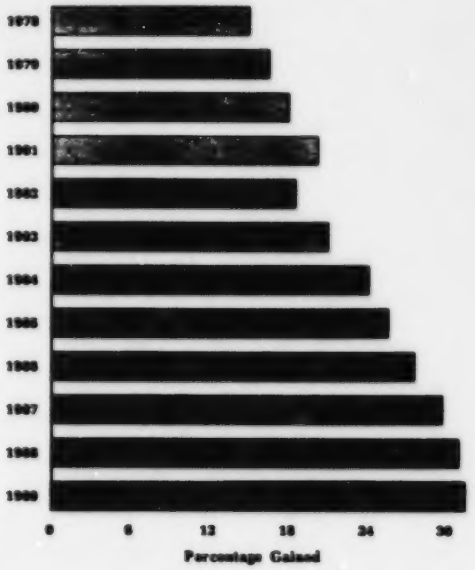
Mining and Metallurgy Industry
Energy Use

Type	Units	Terajoules	1989	1985	1980
Natural Gas	1,465,940,000 m³	54,533	38.1	23.1	18.6
Electricity	11,786,388 MWh	42,431	32.1	41.2	39.6
Liquid Petroleum Products:					
Distillate Oil	179,230 kL	699	0.6	4.4	6.1
Residual Oil	244,728 kL	10,352	8.4	15.6	27.1
Diesel	232,807 kL	9,289	7.6	4.0	2.1
Gasoline	11,935 kL	432	3.5	0.3	0.3
Coal	211,931 tonnes	6,803	3.6	4.9	2.0
Coke	233,347 tonnes	5,437	5.3	5.0	2.5
Other Fuels:					
Propane, LPG	32,330 kL	860	0.5	2.1	1.2
Others (hot water, steam)	n/a	33,439	0.2	0.2	0.5
Totals	1989	164,290			
	1988	135,265			
	1987	133,146			
	1986	98,796			
	1985	119,698			

Petroleum Refining Industry

Energy Conservation Task Force

Glen G. Myers
Chairman



The Petroleum Refining Industry Task Force, established in April 1977, is continuing to report on energy conservation progress in its sector. This report for 1989 is based on submissions from ten companies which process in total about 90% of the crude oil upgraded and refined in Canada.

Major changes in the industry and in the energy monitoring facilities in use have made it necessary to adopt a more recent base year to accurately quantify recent improvements in energy consumption. The year 1985 has been selected as the new reference. For consistency, the energy reduction since 1985 has been added to the 25.6% reduction achieved during the period between the original base year (1972) and the new base year.

Energy Efficiency Improvement Progress

In 1989, the petroleum refining industry achieved a 7.0% net reduction in energy consumption relative to 1985. Compared to the original base year of 1972, the improvement is 32.6%, surpassing the 1990 goal of 30%.

The improvement was achieved in the face of a steady increase in processing intensity resulting from such factors as continued lead phasedown, increased product desulphurization requirements and further product mix changes. Without adjustment to equivalent 1985 operating conditions, the reduction achieved since 1985 was – 1.3%.

Economic Factors Affecting the Industry

Almost all of the major energy conservation projects derived from process studies conducted in the early 1980s have been completed and few capital projects are planned for implementation in the near future. Instability of crude oil and product prices is continuing to complicate investment decisions regarding energy conservation and other projects. As a result, additional near term reductions in energy use will likely come from small investment projects and improvements in control and optimization of present facilities.

Any additional processing facilities needed to meet new government regulations will be designed for high energy efficiency, but will consume some additional energy, and will limit the funding available for other projects, including energy conservation projects.

Specific Conservation Activities

1. Operations and Maintenance: The reduction in energy use achieved in 1989 resulted partly from recently completed projects, and partly from continued improvement in operating and maintenance practices. Energy conservation equipment installed in the mid-1980s reached the time of requiring additional maintenance and tuning. Areas of improvement included:

- Close attention to process settings by operators, supervisors, engineers and management;
- Increased direct responsibility for achieving conservation goals assigned to operators and maintenance workers;
- Continued emphasis on training operators and engineers;
- Continued commitment to timely repair of steam leaks, damaged insulation, steam traps, etc., and to heat exchanger cleaning;
- Optimization of steam systems;
- Improvements in energy monitoring and control techniques;
- Application of process optimization techniques.

2. Capital Projects:

Some capital investment in energy conservation work occurred in 1989, primarily in the following areas, with close attention paid to achievement of project goals:

- Heat recovery facilities, particularly in crude heat exchangers;
- Improvements in plant automation and control;
- Insulation upgrading;
- Reduction in steam consumption;
- Modifications to raise furnace and boiler efficiencies;
- Facilities to reduce fuel gas production.

3. Technology Improvements:

Recent gains in energy efficiency have come partly through application of some of the latest advances in technology. The processes used to upgrade and refine crude oil are complex and the improvements easiest to implement were among the first installed. Accordingly, the industry has a strong interest in applied research and development to attain higher process efficiency. The industry maintains close relationships with scientific and technology research activities worldwide. The types of new technology undergoing rapid development and application include:

- Improved catalysts and additives;
- Facilities to reduce crude oil and product losses;
- New techniques to increase heat recovery;
- Techniques to convert fuel gas components into liquids;
- Advanced computer control and process optimization techniques;
- Sophisticated data management systems;
- Use of high efficiency electric motors;
- Facilities for plantwide monitoring and control of electrical power;
- New types of on-line analyzers;
- Flare gas measurement and recovery.

Task Force Activities

Until now the Petroleum Industry Task Force has been led by two committees: a Steering Committee which sets policy, maintains government relations and establishes funding, chaired by G.G. Myers, and a Technical Committee which reviews industry reporting procedures, receives composite industry data and prepares the annual sector report, chaired by N.J. Little.

To protect the confidentiality of data from individual sources, offices and services of PACE have been used to obtain and consolidate technical data submitted by participating refining companies. It should be noted that all costs involved in the activities of the task force are borne by the petroleum refining industry.

The sector does not consider itself suitable to sponsor or conduct educational workshops. However, member companies are encouraged to participate individually in academic and industrial seminars on energy management and conservation.

Future Outlook

Improvements in operating and maintenance practices and implementation of small capital projects applying recent technological advances will continue to receive the strongest emphasis in the near term, and should yield appreciable improvements in energy use. In Ontario, development of measures to shift electrical loads to accommodate time-of-use electricity rates is continuing.

In the longer term, larger capital expenditures will be required to make further significant progress in energy efficiency in petroleum refining. The investments will proceed if expected rates of return are adequate and capital funds are available. Major advances may be driven largely by the need to reduce emissions of greenhouse gases, particularly carbon dioxide, sulphur dioxide and nitrogen oxides. Reduction in fuel use through energy conservation is gaining support as generally the most cost effective way to curb formation of such gases. The highly competitive nature of the industry and the need to remain competitive will also spur the drive toward higher energy efficiency.

Table I

Petroleum Refining Industry
Energy Efficiency Improvement

Current year (1989) total energy inputs				323.0 petajoules
New base year (1985) equivalent energy inputs				318.9 petajoules
Gross Improvement	1985 to 1989	−1.3%		
Adjustments — (for increased processing severity, changes in product mix, capacity utilization, etc.)				28.5 petajoules
Adjusted base year equivalent				347.4 petajoules
Net Improvement	1985 to 1989		7.0	
Efficiency gain	1972 to 1985		25.6	
Total gain	1972 to 1989		32.6%	

Table II

Petroleum Refining Industry
Energy Used in 1989

Type	Percent
Natural Gas	14.3
Electricity (purchased) (a)	14.2
Liquid Petroleum Products:	
Distillate Oil	—
Residual Oil	7.1
Petroleum Coke	19.6
Other Fuels:	
LP Gas	1.1
Refinery Gas	43.6
Steam (purchased)	0.1
Total	100.0

Energy based on (1) company assigned values, (2) measured thermal values, or (3) U.S. Bureau of Mines values as follows:

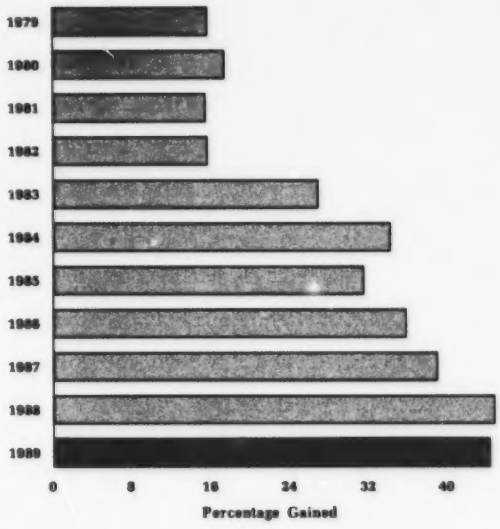
Applied Conversion Factors

	Crude Oil	37.660 GJ/m³
	Distillate	38.655 GJ/m³
	Residual	41.721 GJ/m³
	LPG	26.617 GJ/m³
	Natural Gas	38.414 GJ/m³
	Refinery Gas	36.888 GJ/m³
	Petroleum Coke	38.030 GJ/kg
	Coal	27.935 GJ/kg
	Purchased Steam	2.791 MJ/kg
(a)	Purchased Electricity	10,551 MJ/kWh

Plastics Processing Industry

Energy Conservation Task Force

Chris Leclair
Chairman



This report is based on a survey of the processing sector of The Society of the Plastics Industry (SPI) of Canada. Participants consist mainly of independent extruders, injection blow moulding operators and film producers. Resin suppliers, compounders, distribution companies, equipment makers and a large number of processing operations that are an integral part of other reporting industries (e.g., automotive, electrical and electronic, etc.) are not included in performance results.

In 1989, the value of shipments from the processing sector amounted to $5.6 billion. Based on a total estimated fuel and electricity cost of $95 million for the entire processing sector[1] (including captive operations), this report represents about 28% of the industry's total consumption. The trends described are affected somewhat by minor annual changes in the reporting population and the product mix, but these are not considered detrimental to the overall integrity of the results.

Energy Efficiency Performance and Trends

Energy efficiency levelled off in 1989 with an aggregated result showing a drop of 0.4% as a result of a 7.9% drop in capacity utilization. Nearly three-quarters of the participating companies reported positive results but these gains were more than offset by a few companies that reported either lower production volumes or changes in their product mix. More extensive industry performance declines have occurred in 1980, 1981, and 1985, as shown in Figure 1, because of capacity shrinkages of 3.3%, 6.4% and 3.7%. The 1989 performance was less affected because of the broader base of markets and growing popularity of dedicating optimum sized production machinery to specific products. Some companies that have installed new equipment have been able to selectively shut down less efficient machines.

There is a trend in this industry to add larger capacity and more powerful equipment to satisfy the demand for bigger and more complicated products. This trend is causing a noticeable increase in product energy intensities, especially in the electrical consumption share.

In the surveyed group, electricity provides 46% of the energy but accounts for 77% of the total cost. A small number of reporting companies, mainly in Quebec, use only electricity for power and heating. All of the medium to small companies contract for firm service while only a few of the largest find interruptible contracts cost effective. Approximately one-half of companies with firm-service contracts are now affected by Time-Of-Use (TOU) daily and seasonal rates. In these cases, the recent introduction of TOU rates did not make a noticeable difference in the total cost of electricity because the effects were masked by other production and efficiency changes.

Since 1979, use of electricty has grown from 40% to 46% in the surveyed group. This industry-wide

[1] Statistics Canada Cat. #31-203 and Cansim data.

shift towards greater use of electricity is due to faster growth in the energy intensive injection-moulding sector and installation of additional larger machinery in existing plants. Many of the new production moulding machines come equipped with high-efficiency motors. While it is often difficult to segregate the mix of operations in some reporting companies, it appears that: (1) film makers get about 73% of their energy from electricity; (2) injection-moulders operate in the 62% range; and (3) blow-moulders and custom fabricators are the least electricity intensive-in the 45% range.

The injection-moulders appear to be the most sensitive to power quality problems. Isolated incidents of power surges and harmonic problems were reported which affect computer controls and/or machine shutdown long enough to freeze the resin in the systems. This can result in serious loss of production and changed operating efficiencies.

Natural gas provides 44% of participants' energy and accounts for 19% of total energy cost. While this energy share has gradually declined from 55% in 1979, the proportions supplied by fuel oil have remained steady at about 5%. Blow-moulding and custom fabricators rely on natural gas mainly for building heat and for generation of some process steam. With so much fuel supplied by clean burning natural gas, these processors need not be too concerned with "green house gas"-emissions.

In terms of cost savings, participants continue to benefit from past efficiency gains. Based on an estimated cost of $33 million for fuel and electricity, 1989's total would have been $14 million higher had there been no reduction in overall energy intensities or production efficiency gains. These cost estimates are based on average industry prices of 6.58 cents/kWh, 15.89 cents/m^3 for natural gas, and 32 cents for light fuel oil. Annual energy cost in the surveyed companies varied between $40,000 and $2.5 million.

Energy is considered to be a "medium" and "increasingly" important production cost factor resulting in a renewed emphasis on achieving improvements through low-cost means. Though the surveyed companies reported that 6.9% of capital investment went directly to energy retrofits in 1989, efficiency gains were also attributed to the higher cost replacement of some production equipment. As noted below, further gains via improved operating and maintenance techniques will become more important during periods of slowing capital investment.

The energy versus manufacturing cost percentages in the injection-moulding sector still range upwards to about 15% while the amount is somewhat less – around 10% – for the extrusion and blow-moulding sector, and 5% to 8% in the film making business. These percentages vary significantly because of specific products, geographic location and different regional energy prices.

Energy Management Concerns

This year's survey on the relative importance of energy management, sources of future progress and general barriers to greater efficiency revealed a remarkably consistent pattern of concerns from all participants.

Regarding the relative importance of energy management (scored on a scale of 1 - 10), energy received a 5.5, outranked by: immediate concerns for profit improvement (8.9); product quality (8.7); safety and health regulations (8.3); maintenance of facilities and production equipment (7.4); labour productivity and training (7.3); pollution control (6.2); and general cost control and development of new products (6.1). In light of the energy cost ratios mentioned above and the mandatory nature of most of the other management activities, improving energy efficiency is still a serious concern.

The perceived sources of future improvement differ widely according to the type of processing operation and size of company. For example, while better maintenance (6.9), monitoring and controls (6.5) rated consistently high in all companies, process modifications (aggregated at 6.3) drew a varied response. The collective HVAC potential (6.3), materials handling (5.9), lighting systems (5.5), plant utilities (4.8) and waste heat recovery (4.6) received somewhat less variable but still only moderate concern. Building envelopes and combustion systems are believed to offer the least potential at 4.2 and 3.7. Small companies that rent facilities feel building-related improvements are not their responsibility. In the monitoring and control category, companies known to already have installed state-of-the-art controls still rank this source high. A few of the largest companies are on the verge of installing real-time Data Acquisition Systems (DAS) to prepare for installation of state-of-the-art Computer Integrated Manufacturing (CIM). One of the largest companies was the site of a joint demonstration/monitoring project sponsored by Ontario Hydro and the Ontario Ministry of Energy.

Small companies also recognize the potential of more sophisticated controls and monitoring because they perceive that, even though business is very competitive, there is a great amount of technical knowledge being exchanged within industry.

When it comes to opinions on where to make improvements, the top-rated barriers reflect the primary attention given to the priorities mentioned above. The second great hurdle, showing some consistency at

6.1, was excessively long economic returns. After a variable degree of concern over uncertain business conditions, which often impedes investment decisions, a shortage of technical staff and general technical difficulties scored near the middle range of the scoring system. A general lack of financial incentives and awareness of opportunities were the lowest-rated impediments to future improvements.

From the low rating (2.9) given to the notion that almost all of the feasible savings have already been achieved, the survey results indicate that management feels there is much work yet to be done. It would also suggest the total improvement target figure of 50% by 1990 relative to 1980 levels may yet be possible, as well as more significant achievements in years to come.

Table I

Plastics Processing Industry
Energy Use

Type	Units	Terajoules	Percentage Distribution 1989	1985	1979
Electricity	385,478 MWh	1,387.7	46.1	43.2	40.0
Natural Gas	38,568,177 m^3	1,434.7	47.7	47.2	55.5
Liquid Petroleum Products:					
Distillate Oil	1,630,086 L	63.7	2.1	1.1	1.0
Residual Oil	1,165,200 L	47.2	1.6	3.5	3.0
Diesel & Gasoline	584,837 L	22.9	0.7	0.6	0.2
Other Fuels:					
Others	—	40.5	1.3	—	—
Propane	415,639 L	11.0	0.4	0.2	0.6
Total		3,007.7			

Performance Statistics

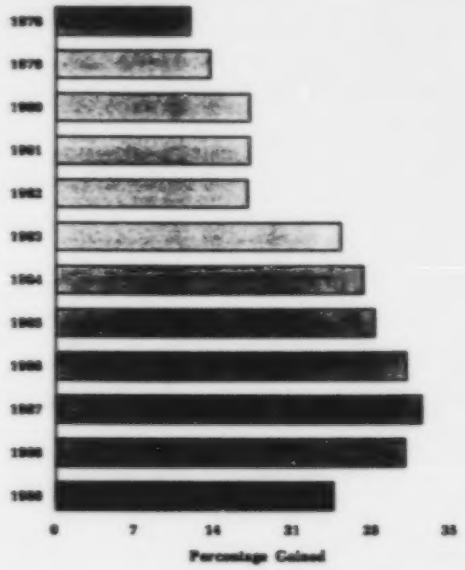
Current year total energy inputs: 3,007.7 Terajoules
Base year (1985) equivalent inputs: 3,162.4 Terajoules

Efficiency Improvement 1979 to 1985	=	31.48%
1986	=	4.35%
1987	=	3.63%
1988	=	5.49%
1989	=	0.41%
Total		44.54%

Pulp and Paper Industry

Energy Conservation Task Force

M.J. Frost
Chairman



Sector Description

The Canadian Pulp and Paper Association's Energy Monitoring Report covers 120 mills accounting for about 95% of the total pulp, paper and paperboard produced in Canada in 1989. Five of the mills included in the report are not members of the Association. A list of participating companies is appended.

Progress Toward Improved Energy Use Efficiency

Purchased energy per tonne of product increased slightly during the year, with the result that the reduction in purchased energy since 1972 now represents 25.8% versus the industry's objective of 33% reduction for the year 1990.

The major energy source continues to be purchased electricity which accounts for 36.7% of the total purchased energy. Heavy fuel oil is 30.1% of the total, which is 45% of the amount used on an equivalent production basis in 1972. Natural gas has increased to 29.5% of the total.

On a unit energy basis, there was a continued reduction in the use of purchased electricity in electric boilers, which was more than offset by increases in the use of heavy fuel oil and natural gas. Purchased electricity for motive power continued to increase in 1989, reflecting the trend of increasing mechanical pulping capacity.

The reduction in heavy fuel oil use is equivalent to 3.05 billion litres, and in total purchased energy use is equivalent to 2.93 billion litres of heavy fuel oil when compared to the base year of 1972.

Operating Conditions

Shipments of pulp, paper and paperboard for the year 1989 were marginally down from the previous year. The industry as a whole operated at 93% of capacity for the year.

Replacement of fossil fuels by wood wastes generated by the industry and neighbouring wood products operations declined slightly during the past year. These wood wastes now account for 64% of total fuels burned by the industry. Waste fuels plus captive hydraulic power account for 53% of total energy, up from 42% in 1972.

Technological Developments

The Edmundston, New Brunswick mill of Fraser Inc. was awarded CPPA's Technical Section Energy Conservation Opportunity Award in 1989. Stricter control on incoming wood supply and better inventory practices resulted in reduced power consumption at the grinders, a higher production rate, and higher pulp brightness.

There are several benefits from implementing this type of control on incoming wood supply and inventoried stock. First, newer wood with higher moisture content is easier to grind, which results in less power consumption at the grinders and a higher production rate at the same time. Second, the new wood provides groundwood pulp with a higher brightness.

Power savings of 16,570 mwh for 1988 are equivalent to $494,000 based on an average purchased power cost of $29.81/mwh.

PAPRICAN's research program continues to include many projects with energy conservation aspects. This results in the generation of technological concepts that yield potential reductions in energy consumption and improved overall energy management.

Table I

Pulp and Paper Industry
Energy Efficiency Improvement

Current year (1989) total energy inputs — 352.31 x 10^{15} Joules

Base year (1972) equivalent energy inputs — 474.86 x 10^{15} Joules

$$\text{Improvement} = \frac{\text{Base year equivalent} - \text{current year inputs}}{\text{Base year equivalent}}$$

$$= \frac{474.86 - 352.31}{474.86} = 25.8\%$$

Adjustments — None

Survey Data

Number of companies in 1989 report	61
Number of plants in 1989 report	120
Current year consumption	352.31 X 10^{15} Joules
Current year production	25,649,471 tonnes
Base year consumption	352.50 X 10^{15} Joules
Base year production	19,040,808 tonnes
Base year volume equivalent consumption	474.86 X 10^{15} Joules
1990 goal (relative to 1972 base year)	33%

* Base year (1972) equivalent energy inputs = base year consumption x $\frac{\text{current year production}}{\text{base year production}}$

Table II

Pulp and Paper Industry
Purchased Energy Consumption

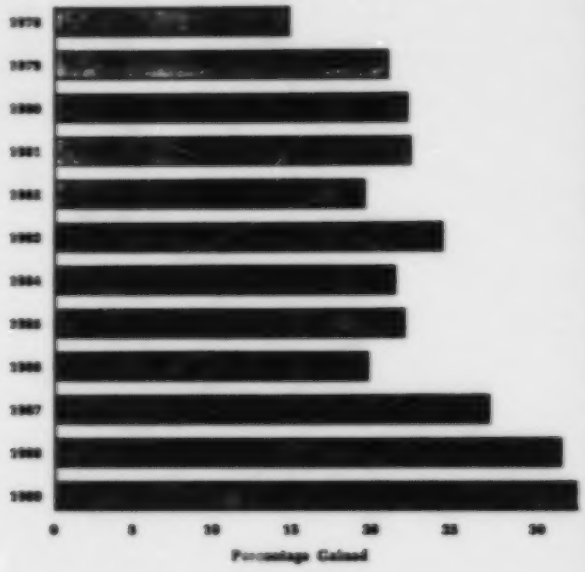
Energy Source	1972* Joules X 10^{15}	Percentage of Total	1988** Joules X 10^{15}	Percentage of Total	1989** Joules X 10^{15}	Percentage of Total
Coal	16.23	3.4	4.86	1.5	4.11	1.2
Petroleum Products:						
Residual Oil	233.35	49.2	81.92	24.4	105.91	30.1
Distillates	8.74	1.8	4.76	1.4	4.83	1.4
Natural Gas	95.68	20.2	94.02	28.1	103.96	29.5
LPG	1.05	0.2	0.89	0.3	0.81	0.2
Other	4.94	1.0	1.41	0.4	3.27	0.9
Electricity (purchased)	114.87	24.2	147.09***	43.9	129.42****	36.7
Totals	474.86	100.0	334.95	100.0	352.31	100.0

*Reported on 1972 unit use adjusted to 1989 production
**Actual Use
***21.56 X 10^{15} Joules (6.4%) used in electric boilers
**** 3.18 X 10^{15} Joules (2.5%) used in electric boilers

Textile Industry

Energy Management Task Force

J. Guy Morin
Chairman



The Energy Management Task Force of the Canadian Textiles Institute represents more than 90% of Canada's textile production.

The textile industry is large and diverse. During 1989 it employed 59,500 Canadians and shipped goods valued at $6.6 billion, down from $6.7 billion in 1988.

When the public thinks of textiles, the products which first come to mind are clothes, but this is a far from accurate picture of the industry. While 40% of textile production is shipped to the clothing industry, 60% is sold to over 150 manufacturing industries and to the consumer in the shape of finished goods such as carpets, towels and bed linens. In 1989 the textile industry exported 12.5% of its production.

While textile producers do process and manufacture the natural and synthetic fabrics that clothe us, they also produce the fabrics that furnish our homes and provide the fire hoses that protect them. Ropes, safety harnesses, cords, cordage and twine are all examples of traditional textile products. The industry also produces many space-age products, among them soft body armour and synthetic arteries.

In the construction industry, textiles help make our roads stronger and our homes and offices more energy efficient. Geotextiles are used to reinforce and strengthen airport runways and major highways. Energy efficient textiles are wrapped around commercial and residential buildings before the brick or siding goes on in order to cut wind penetration and allow trapped moisture to escape.

The textile industry is made up of companies that sell their products to other manufacturing and industrial sectors such as the apparel industry. In the case of products such as carpets, towels and blankets, they are sold directly to the consumer.

1989 Performance

In the textile industry there is a strong correlation between capacity utilization and energy efficiency. Because of the economic slowdown which started in 1989, textile mills did not run at full capacity, and this, combined with a colder than average December in Quebec, resulted in an energy efficiency loss of 3.3% per kilo of product. When viewed in terms of 1981 constant dollars, the energy efficiency decline almost matches the decline in the value of goods shipped from $5.553 billion in 1988 to $5.374 billion in 1989 (a decline in value of 3.2%).

When 1989's declining energy efficiency of 3.3% is deducted from 1988's impressive 5.0% energy improvement, the Textile Task Force stands at an overall energy gain of 28.3%. This is within 7% of the original 1990 target of an energy gain of 29%, and within 2.7% of the new target of a 31% energy efficiency gain now set for 1990.

Task Force Activities

The textile industry has been much concerned with the effects of the Free Trade Agreement and the Canadian International Trade Tribunal's recommendations that textile tariffs be drastically reduced. Also of concern to the textile industry is the current Uruguay Round of the General Agreement on Tariffs and Trade (GATT) negotiations, which is ex-

pected to have significant impact on textile products.

These factors combined with the slowing economy have created a climate of economic uncertainty in the textile industry. This has effectively limited the task force's activities and the industry's interest in energy efficiency.

As well, 1989 has seen an almost complete change of personnel in task force staff. The Energy Management Committee of the Canadian Textiles Institute would like to take this opportunity to thank Luis G. Monton, the former chairman, and Jim Robertson, the former secretary, for their unstinting labour and deep commitment to the cause of energy efficiency. At the same time, the Committee applauds the appointments of Guy Morin as chairman, Guy Leclerc as chairman of the Technical Liaison Subcommittee and Pierre Gagnon as secretary.

Given these developments, the task force spent 1989 in reorganization, deliberating on how best to meet the challenges confronting it.

The economic uncertainty created by the Free Trade Agreement, the Canadian International Trade Tribunal recommendations, and the current round of GATT talks, has left the textiles industry in a position where the investment required to produce outstanding energy efficiency gains is not warranted at present.

To counter this atmosphere, the Energy Task Force has designed a program aimed at restoring the importance of energy management as a vital aspect of profit and loss. Because the efficient use of energy reduces pollution, energy efficiency will be tied to environmental concerns.

The Task Force is planning a series of publications aimed at CEO's that will sidestep energy efficiency as a long-range practical necessity and focus instead on its importance to yearly profits.

The publications will be brief, in light of the limited time CEO's have to consider extraneous matters. They will also be designed to underline the necessity for plant managers to attend energy management meetings.

To attract more industry participation, the task force has decided to change its meetings into half-day seminars. Where once the emphasis was on the necessity for long-term energy planning, it will now be placed on how to make the most of the present situation.

The seminars will focus on a "nuts and bolts" approach to energy efficiency. Technological innovations and the new generation of energy efficient machinery, as well as recent case histories such as the installation summarized below, will be discussed.

In the past, the Textiles Task Force published two newsletters, Energy Mangement Notes, designed to raise energy efficiency awareness and Energy Management Techniques, devoted to case histories and practical energy efficiency concerns. The two publications will now be consolidated into Textile Energy Management Techniques. The consolidated publication will feature articles on reducing textile production costs through energy efficiency.

Textile Energy Management Techniques will provide information on new technologies and show what can be done by providing thorough case histories of successful textile industry energy efficient installations. It will also provide the details of energy efficiency programs run by the government and power companies. For the first time, energy efficiency will also be discussed in environmental terms.

Case History

Many textile operations require large amounts of energy to heat water for processes such as dyeing and bleaching. In one bleaching operation the following conversion took place. The technology used, natural gas-fired direct contact hot water heating, is typical of the new technologies which the Textile Task Force intends to help introduce to the industry in the coming years.

In this case, an eight-year-old steam driven Pick Heater, which ran at 65% efficiency, was replaced by a direct contact gas-fired hot water heater which runs at 99.9% efficiency. The new installation took one week to put in place and contains two burners and two blowers which produce 20 million BTU's an hour and 300 U.S. gallons of hot water per minute. Water temperatures can range from 32° F to 180° F. At the highest water temperatures, the heater will lose some of its efficiency.

By installing the direct-fired gas hotwater heater, manufactured by Sofame Inc., the plant saved the expense of adding a back-up boiler to its operation.

Purchase and installation cost roughly $100,000. Estimated energy savings for the first year of operation are $172,000. The payback period is expected to be in the neighbourhood of six months, depending on demand. After four months everything is on stream and plant management plans the installation of another Sofame direct-fired gas water heater to temper water in the boiler room. The hot water heaters are semi-automatic and require intervention only when it is necessary to restart them. Management expects to gain further savings through supervisory personnel reductions in the future.

It is the use of this type of energy efficient machinery, which can be introduced when financial conditions warrant, that the Textile Task Force intends to encourage.

Energy Use Patterns

The consumption of various types of petroleum showed very little change in the textile industry during 1989, remaining almost the same as last year. However, as a percentage of total consumption, the use of natural gas rose to 61.7% in 1989, against 55.0% in 1988. The jump in

natural gas consumption was made at the expense of electricity, which fell to 27.1% of all energy consumed in 1989, against 35.1% in 1988. The drop in the consumption of electricity is within .7% of the jump in natural gas consumption.

This change is explained by the growing cost of electricity in Quebec and Ontario and the economies in energy costs to be gained by using natural gas.

Future Outlook and Concerns

Future energy efficiency gains in the textile industry are problematic. Energy efficiency in the industry is dependent on the state of the economy. If the mills run at capacity, gains will be made. If the economy slows down, losses will occur.

Against this background the textile industry is in a state of flux. While it is a highly competitive and forward looking industry, it is faced with a period of economic uncertainty brought on by the Free Trade Agreement, the Canadian International Trade Tribunal recommendations and the current round of GATT negotiations. Until the results of these trade agreements are fully analyzed, it is unlikely that the textile industry will invest the amounts of capital needed to produce major energy efficiency gains.

Table I

Textile Industry
Energy Efficiency Improvement

Current year (1989) total energy inputs	8,439,057 gigajoules
New base year (1985) equivalent energy inputs	8,996,862 gigajoules

Net Improvement = 3.3%

Adjustments — None

Efficiency gain 1974 - 1985	22.1
1986	–2.3
1987	6.8
1988	5.0
1989	–3.3
Total gain 1974 - 1987	28.3%

Table II

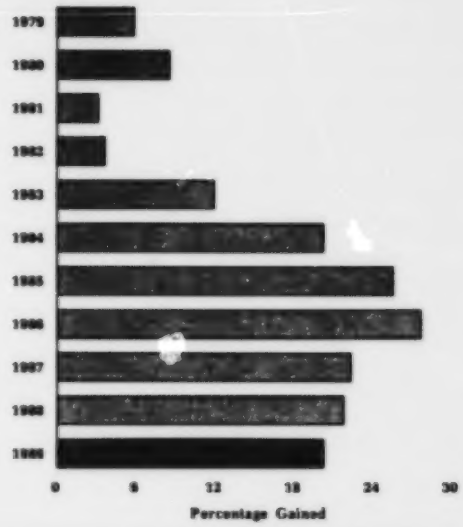
Textile Industry
Energy Use

Type	Units	Gigajoules	Percentage of Total Consumed 1985	1989
Natural Gas	139,973,000 m^3	5,207,014	58.4	61.7
Electricity	634,407 MWh	2,283,865	32.3	27.1
Liquid Petroleum Products:				
Residual Oil	20,697 kilolitres	875,504	8.5	10.4
Distillate Oil	353 kilolitres	13,767	0.2	0.2
Diesel & Gasoline	314 kilolitres	11,948	0.2	0.1
Other Fuels:				
Propane & LPG	1,760 kilolitres	46,808	0.5	0.6
Total (1989)		8,439,057		

Transportation Industry (Manufacturing)

Energy Conservation Task Force

Ken Rossi
Chairman



Task Force Profile

The Transportation Industry (Manufacturing) Task Force has a membership of 531 companies in the following six trade associations:

- Aerospace Industries Association of Canada (AIAC)
- Allied Boating Association of Canada (ABAC)
- Automotive Parts Manufacturers' Association (APMA)
- Canadian Marine Industries Association (CMIA)
- Canadian Truck and Trailer Manufacturers' Association (CTTMA)
- Motor Vehicle Manufacturers' Association (MVMA)

There are 87 companies reporting energy usage for 1989, an increase of 50% over 1987. While the number is down slightly from 1988, no doubt due to the declining industry economic conditions since early 1988, we are nevertheless pleased with the continued and energetic activities of the task force, which has been successful in maintaining this high level of participation.

The 1989 survey trends reflect performance in a very diverse group of large and small companies. Some 68% of consumption was reported by the large MVMA companies, 23% by the 44 APMA companies, and 9% by 39 diversified members of the AIAC, ABAC, AMIA, and CTTMA associations.

Task Force Activities

The Transportation Task Force continues its mission with monthly meetings and regular technology transfer seminars. Executive meetings usually include representatives of EMR, Ontario Ministry of Energy, and Ontario Hydro, whose organizations help co-sponsor seminars such as "Energy Management for the 90's" held in September.

The highly successful IDEA EXCHANGE newsletter, providing information on energy-related programs, available assistance from government and utilities, case-studies from participating companies, etc., is a continuing effort of this task force. This information source also receives wide distribution through trade association media services.

The task force also continues to promote its work through other agencies. For example, the Ontario Ministry of Energy's widely distributed "Source Book" was used to advertise the work of the task force in 1989.

1989 Performance

As shown in the sector performance table, consolidated performance has declined 2.2% during 1989, which drops the group's efficiency 6% below 1985 base year levels. However, consolidated efficiencies are 19.6% better than 1978 operating conditions. While recent trends are disappointing, it must be appreciated that the 1985 reference year was exceptionally good, and subsequent performances are therefore measured against a very high standard. It is also increasingly difficult to aggregate performances in this industry because of frequent changes in products, moderate extent of custom work, and rapid swings in consumer markets.

Nevertheless, individual companies find the performance tracking very useful for identifying the cost impact of changes in productivity.

Sector Performance

ABAC (Boating) and CTTMA (Truck/trailer)

Energy use by companies in these two associations represents less than 1% of the total surveyed by the task force and performance has been difficult to quantify because of widespread industry rationalizations and

the custom nature of production. However, their participation is valuable since it provides a broader perspective on the industry's operating conditions and therefore its performance.

AIAC (Aerospace)

The 27 reporting companies are located mainly in Ontario, Quebec, and Manitoba. Energy usage efficiency is now 3.7% below the 1985 reference point although in the 6-year period prior to 1985, this group had recorded a gain of 20%.

Much of the efficiency loss has resulted from major environmental retrofits required to improve plant safety and health standards. Colder weather in 1989 affected heating requirements, and transfer of some production to parent U.S. plants has also reduced output volumes.

APMA (Auto Parts)

Major efforts to improve productivity throughout this sector have led to an energy end-use efficiency gain of nearly 2% over 1988. Efficiency in the 44 reporting companies is now 6% better than 1985 base year levels.

Companies in this group are upgrading as rapidly as possible to satisfy the stringent production and cost demands of MVMA companies and the fierce competition from offshore and Mexican operations. Production techniques have gone beyond basic Just-In-Time (JIT) concepts. Many companies have now had to adapt plant operations to customers' high standards to ensure there is no weak link in the chain of supply.

CMIA (Shipbuilding)

Energy consumption in the nine reporting companies fluctuates widely from year to year because of unsteady production volumes and uncertain future business. However, energy use per unit of output is now 5.8% below 1985 standards.

MVMA (Motor Vehicles)

MVMA companies' energy efficiency slowed about 1% in 1989, which made the overall performance 9.2% less than peak levels achieved in the 1985 reference year.

Much of the increased energy end-use is attributed to high levels of reconstruction, retooling to accommodate model changeovers, and the added environmental controls of the past few years. More energy is required to control emissions from new painting operations and foundries and to operate extra HVAC comfort equipment.

Lower capacity utilization is also a major factor in the decline of energy efficiency. After a peak of 84.9% in 1985, capacity slid to a low of 65% in the first quarter of 1989 and is forecast to remain low unless there is further rationalization in the industry.

Nevertheless, significant energy conservation improvements have been achieved. For example, in automotive assembly plants where disposal of packaging and shipping materials has always been a major problem, significant portions of steam demand are now generated from these combustible wastes.

A "solar wall" demonstration project at a major automotive plant in Oakville, Ontario, with partial funding from EMR, is now recognized as a major development in storage tank heating. Similar installations are going into service elsewhere in Canada, the United States, and other industrial plants around the world. The developer has recently won an ASHRAE regional award and has been nominated for national recognition.

As well, Ontario Hydro's Energy Management Challenge program has sponsored major lighting retrofits plus installation of many high efficiency motors and variable speed drives.

Energy Use Patterns

Steadily increased use has pushed the natural gas share of total consumption to 60%. The 2% token share of residual oil and 1% for light fuel oil are used mainly for back-up service to satisfy interruptible natural gas contract requirements.

The increasing proportion of electricity, now about 30%, is being monitored carefully because of growing cost and little possibility of substitution.

Coke continues to be a vital source of energy in the MVMA and APMA member companies' foundry operations, with a steady 5% - 7% share over the past ten years.

Future Outlook and Concerns

The principal companies in this task force, members of MVMA and APMA, are confronted with extreme competition in a declining market as well as debilitating overcapacity in the North American industry.

There is also a recognized need to realistically address pressing environmental issues that have now become a major component in corporate planning. Solutions to many of these problems are expensive and it must be acknowledged that in many instances, the technologies utilized in reducing emissions from factories and enhancing the environmental friendliness of the industry's products require some sacrifices in energy efficiency.

Therefore, energy managers must continue to be aware of new energy conservation and environmental technology developments as well as the impact of changing energy costs and potential problems in energy supply and distribution infrastructures.

We are confident that significant gains will continue to be accomplished in the improvement of energy efficiency and environmental integrity, and that organizations such as CIPEC have a great role to play in this combined effort.

Table I

Transportation Industry (Mfg.)
Energy Efficiency Improvement

Current year (1989) total energy inputs — 52,382,420 gigajoules

New base year (1985) equivalent energy inputs — 49,412,716 gigajoules

Net Improvement = –6.0%

		Total gain since 1978
Efficiency gain 1978 - 1985	25.6	25.6
1986	2.1	27.7
1987	–5.4	20.2
1988	–4.9	20.7
1989	–2.2	19.6

Table II

Transportation Industry
Energy Use

			Percentage of Total Consumed								
Type	Units	Gigajoules	1989	1988	1987	1986	1985	1984	1983	1982	1981
Natural Gas	851,018,197 m^3	31,657,877	60.4	57.9	58.7	55.7	54.7	54.1	52.1	53.0	49.1
Electricity	4,108,470 MWh	14,790,497	28.2	31.5	32.8	30.7	30.1	29.3	28.4	25.9	23.6
Liquid Petroleum Products:											
Distillate Oil	13,164,541 litres	513,417	1.0	1.2	0.8	1.3	1.2	1.2	1.4	1.8	0.7
Crude Oil	n/a	—	—	—	—	—	0.2	—	—	—	—	—
Residual Oil	29,003,800 litres	1,174,687	2.2	1.7	1.7	1.8	2.1	3.8	8.3	7.5	14.7
Gasoline	647,598 litres	23,454	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.2
Diesel	1,062,025 litres	42,375	0.1	0.1	0.1	0.1	0.2	0.3	0.2	0.4	0.3
Turbine Fuel	3,085,011 litres	111,677	0.2	—	—	—	—	—	—	—	—
Coal	36,586 tonnes	994,773	1.9	1.8	2.2	3.5	3.5	3.5	4.0	3.9	5.9
Coke	94,622 tonnes	2,858,534	5.5	5.4	5.5	6.1	7.4	7.3	7.2	5.8	5.1
Other Fuels:											
Propane	7,959,054 litres	211,483	0.4	0.4	0.2	0.5	0.8	0.3	0.3	0.4	1.4
LPG	135,639 litres	3,676	0.1	0.1	0.1	—	—	—	—	—	—
Total		52,382,420									

Table III

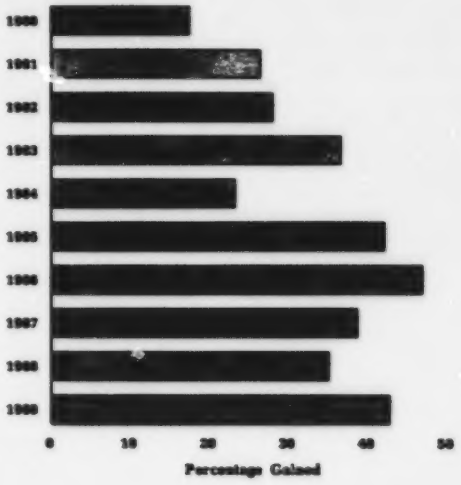
Transportation Industry
Energy Efficiency

		Base Year 1985						Base Year 1978			
Subsector		1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979
ABAC	(Boating)	—	—	—	—	—	2.9	3.1	–48.5	–88.1	—	–0.7
AIAC	(Aerospace)	–3.7	2.8	5.2	5.2	20.5	7.9	7.8	3.9	–43.7	6.0	–1.2
APMA	(Auto Parts)	6.0	4.9	3.0	2.7	8.5	13.5	11.7	5.8	26.7	15.6	3.3
CMIA	(Shipbuilding)	–5.8	1.9	15.2	–19.4	11.4	–3.9	–10.8	–21.2	48.1	–14.1	–9.9
CTTMA	(Truck/Trailer)	—	–0.2	9.0	—	–26.3	–15.4	–58.9	–65.2	25.8	–18.1	–0.2
MVMA	(Motor Vehicles)	–9.2	–8.6	–8.8	2.0	28.8	22.8	–6.3	3.3	—	—	—
Task Forces		–2.2	–4.9	–5.4	2.1	25.6	20.3	1.2	3.7	8.9	4.5	–0.4

Wood Products Industry (Western)

Energy Conservation Task Force

R.C. (Dick) Bryan
Chairman



Task Force Description

The Wood Products Industry (Western) Task Force was formed by the Council of Forest Industries of British Columbia (COFI) in 1978. It represents 80 companies with more than 100 sawmills and 15 plywood and veneer mills. COFI members and affiliates account for more than 90% of the total product value of the forest industries in British Columbia.

Most mills in western Canada are members of industry trade associations which actively pursue a variety of business issues of common interest. In British Columbia, the major forest industry associations are the Council of Forest Industries of B.C., its Northern Interior Lumber Sector (NILS), the Cariboo Lumber Manufacturers' Association (CLMA) and the Interior Lumber Manufacturers' Association (ILMA). CLMA and ILMA are also affiliate members of COFI.

This survey covers 60 operating sawmills owned by 18 companies which accounted for 47% of the lumber produced in B.C. in 1989. The coverage in 1989 represents an increase over the 1988 survey which accounted for 43% of B.C. production. The reporting sample covers mills of all sizes and represents all regions in B.C. as well as an Alberta sawmill.

Goals and Progress to Date

The industry's target for 1990 is a 7% overall increase in energy efficiency from 1985 base year performance. The industry's overall average efficiency improvement of 7.3% in 1989 versus 1985 exceeded this target. Although the 1989 performance represented an improvement over 1988, it was one that was based almost entirely on efficiencies in the use of natural gas. The results also show an improvement of 46.9% over the 1978 base year.

Average electrical energy consumption for the production of green lumber showed no significant improvement over 1988 and none of the lost ground since 1985 was made up. Energy use on a comparable basis was 8.4% more than in 1985. The 1989 performance, when compared with 1978, represented a 12.1% improvement.

Compared to 1988, there was significant improvement in the average natural gas consumption in the kiln drying of lumber in 1989. The improvement was 20.8% when compared to the 1985 base year and 63.9% improvement when compared to the 1978 base year.

It is gratifying to see respondents' support for the survey continue to grow in recent years and we are now reporting on close to one-half of the total lumber production in the province. The reporting sample for kiln-dried lumber grew in 1988 and that gain has been maintained in 1989.

There is no obvious, single reason why electrical energy use in mills converting logs to green lumber

was below the efficiency performance attained in 1985. Sawmills in British Columbia continued to be faced with higher stumpage charges than prior to 1987 and this may be reflected in higher electrical usage in several ways. First, those mills which are high volume commodity-type lumber producers concentrate on achieving the highest possible volume of output, i.e. lowest unit cost, and may be paying attention to only major cost items – wood and labour. For these sawmills, electricity represents a small cost. Other types of mills which are cutting for value rather than volume will be more concerned that they are maximizing the value from each log and this may mean less concern is paid to the smaller costs such as electrical energy use.

In the interior of the province it is customary to kiln-dry lumber using either natural gas or wood waste energy systems. When natural gas prices were rising through the late 1970s and early 1980s, many mills switched from natural gas to wood waste energy systems. Several years ago, as a result of deregulation of natural gas in the province, natural gas prices fell significantly, making that fuel more attractive. In the last year or so, natural gas prices have stabilized. Consequently, there has not been a strong economic incentive to convert from natural gas to wood waste systems, although progress has been made both in conversions and in improvements to all types of kiln-drying techniques. Natural gas producers are beginning to exert upward pressure on prices and this should result in more conversions to wood waste energy systems in future.

The improvement noted in the natural gas performance is also due, in part, to the fact that our sample of mills varies from year to year. Variations in our reporting sample mean that relatively small changes in the sample can affect natural gas energy performance.

Energy-Related Activities

COFI continues to provide a secretariat/coordinating role regarding the B.C. wood products industry's energy initiatives. Typically, these activities focus on regulatory matters but include other aspects such as the terms and conditions of energy supply.

Activities in 1989 centred on the proposed natural gas pipeline to Vancouver Island and the possibility of replacing heavy fuel oil, both local and imported, with B.C. natural gas. The other major activity in 1989 was the Westcoast Energy Hearing which dealt mainly with rate concerns and the issue of capacity on the transmission line.

Energy conservation activities were largely limited to collecting, analysing and reporting on the energy performance data contained in this report.

Future Outlook

Following a slight decline in 1989, lumber production in B.C. is expected to improve marginally in 1990. Exports to the U.S. are expected to be stable and offshore markets should strengthen modestly.

Profitability has been virtually non-existent in the B.C. lumber industry for several years, due in part to the increased stumpage charges mentioned earlier and the increase in the value of the dollar. Economic forecasts of an improvement in 1991 should be reflected in lumber markets. It is not clear how the stumpage situation will resolve itself although most forecasters do expect a drop in the value of the Canadian dollar.

Over the longer term, there is a strong movement in B.C. to reduce the output of commodity-type lumber and to replace that production with higher value-added products.

Wood Products Industry (Western)
Energy Efficiency Improvement

Green Lumber	1989	1985	1978
Total sample production (million board feet — MMFBM)	7221.3	5052.0	4202.2
Total electrical energy consumption (10^{12} J)	3472.3	2241.5	2297.7
Average electrical energy consumption (10^{9} J per MFBM)	0.481	0.444	0.547
Current year total electrical energy inputs (10^{12} J)	3472.3	2241.5	2297.7
Comparison base year (1985) equivalent energy inputs (10^{12} J)	3203.9		
Comparison base year (1978) equivalent energy inputs (10^{12} J)	3948.5		

Improvement (1985 base year) = –8.4%

Improvement (1978 base year) = 12.1%

Kiln Dried Lumber	1989	1985	1978
Total sample production (MMFBM)	4816.4	3159.4	1013.0
Total energy consumption (mainly natural gas) 10^{12} J	2936.4	2433.0	1708.8
Average energy consumption (10^{9} J per MFBM)	0.610	0.770	1.687
Current year total energy inputs (10^{12} J)	2936.4	2433.0	1708.8
Comparison base year (1985) equivalent energy inputs (10^{12} J)	3709.0		
Comparison base year (1978) equivalent energy inputs (10^{12} J)	8124.6		

Improvement (1985 base year) = 20.8%

Improvement (1978 base year) = 63.9%

Combined Energy Performance	1989 Actual	1985 Equiv.	1978 Equiv.
Total electrical energy consumption (Green Lumber 10^{12} J)	3472.3	3203.9	3948.5
Total natural gas consumption (Kiln Dried 10^{12} J)	2936.4	3709.0	8124.6
Total sector energy consumption 10^{12} J	6408.7	6912.9	12073.1

Improvement (1985 base year) = 7.3%

Improvement (1978 base year) = 46.9%

Reporting Companies

Chemical

Atkemix Inc.
BASF Canada Inc.
H.L. Blachford Ltd.
Carbochem Inc.
Commercial Alcohols Limited
Cyanamid Canada Inc.
Dow Chemical Canada Inc.
DuPont Canada Inc.
Esso Chemicals Canada
General Chemical Canada Inc.
B.F. Goodrich Canada Inc.
Henkel Canada Inc.
Hoechst Canada Inc.
M & T Chemicals Ltd.
National Silicates Limited
Nitrochem Inc.
Novacor Chemicals Ltd.
Oxychem Canada Inc.
QueNord Inc.
Shell Canada Chemical Company
Sulco Chemicals Limited
Surpass Chemicals Ltd.
Tioxide Canada Inc.
Union Carbide Canada Limited
Uniroyal Chemicals Inc.

Electrical and Electronic

3M Canada Inc.
Alcan Wire and Cable Ltd.
Allen-Bradley Canada Ltd.
Andrews Antenna Co. Ltd.
Appleton Electric Limited
Arcair Canada Limited
CAE Electronics Ltd.
Camco Ltd. (Hamilton, Ont.)
Camco Ltd. (Montreal, Que.)
Canada Wire and Cable Ltd.
Ceyelec Industrie Inc.
Commander Electrical Equipment Inc.
Commander Electrical Materials Inc.
Eaton Yale Ltd.
Edwards, a unit of General Signal Ltd.
Erico Canada Inc.
General Wire & Cable Ltd.
Gennum Corporation
Gould Shawmut Company Ltd.
GTE Sylvania Ltd.
Hamilton Porcelains Limited
Honeywell Limited
Hoover Canada Inc.
Hubbell Canada Inc.
Iona Appliances Inc.
ITT Cannon Canada
Klockner Moeller Ltée
Lincoln Electric Co. of Canada Ltd.
Lumacell Inc.
MIL Tracy
Moloney Electric Corporation
Motorola Information Systems
NEI Ferranti Packard Electronics
Novatel Communications Ltd.
Ouellet Canada Inc.
Philips Electronics Ltd.
Pursley Inc.
Reliance Electric Limited
Rockwell International of Canada Ltd.
Smith & Stone (1982) Inc.
Spar Aerospace Limited
Square D Canada Ltd.
Temco Electric Products Co. Inc.
Thomas & Betts Ltd.
Thomson Consumer Electronics
Trench Electric
WCI Manufacturing Limited (Cambridge, Ont.)
WCI Manufacturing Limited (L'Assomption, Que.)
Woodhead Canada

Ferrous Metals

The Algoma Steel Corporation
Dofasco Inc.
Stelco Inc.
Sydney Steel Corporation (Sysco)

Food and Beverage

Bakeries

Ben's Limited
Corporate Foods Limited
Eastern Bakeries Limited
McGavin Foods Limited
Multi-Marques Inc.

Biscuit Manufacturers

Christie Brown & Company Ltd.
Colonial Cookies Ltd.
Aliments Culinar Inc.
Interbake Foods Limited
Manning Biscuits Ltd.
Windsor Wafers Inc.

Breweries

Labatt Breweries of Canada Limited
Molson Breweries of Canada Limited
Moosehead Breweries Limited
Northern Breweries Ltd.
Pacific Western Brewing Co. Ltd.
Upper Canada Brewing Co. Ltd.

Confectionery Manufacturers

Adams Brands Inc.
Donini Chocolate Ltd.
Ganong Brothers Ltd.
Hershey Canada (Montreal) Inc.
Kerr Bros. Limited
Leaf Confections Ltd.
Nestlé Enterprises Ltd.
O-Pee-Chee Company Ltd.
Rowntree Mackintosh Canada Ltd.
Trebor Canada Inc.
William Neilson Ltd.
Wrigley Canada Inc.

Distilleries

Alberta Distillers Limited
Canadian Mist Distillers Limited
FBM Distillery Co. Limited
Gilbey Canada Inc.
Gooderham & Worts Limited
Hiram Walker & Sons Limited
Joseph E. Seagram & Sons Limited
Liqueurs Saguenay Ltée
Palliser Distillers Limited
Schenley Canada Inc.

Food Processors

Campbell Soup Company Ltd.
Hunt-Wesson Canada Ltd.
H.J. Heinz Company of Canada Ltd.
Kellogg Canada Inc.

Morrison Lamothe Inc.
Omstead Foods Ltd.
Produce Processors Limited
Royal City Foods Ltd.
Snowcrest Packers Ltd.
Sun-Brite Canning Ltd.
Sunland Foods Ltd.
Sun-Rype Products Ltd.
Thomas Canning (Maidstone) Ltd.
Trebor Canada Inc.

Fisheries

British Columbia Packers Limited
Blue Water Seafoods Limited
Connors Bros., Limited
National Sea Products Limited

Grocery Products Manufacturers

Agropur Cooperative Ltée
Campbell Soup Company Ltd.
Canadian Home Products Ltd.
Catelli Inc.
Culinar Inc.
General Foods Ltd.
Jacobs Suchard Canada Inc.
Kellogg Canada Inc.
Kraft Ltd.
Lancia Bravo Foods Limited
McCormick Canada Inc.
Monarch Fine Foods Ltd.
Nabisco Brands Ltd.
Nacan Products Ltd.
Warner-Lambert Canada Inc.

Meat Processors

Burns Meats Inc.
Canada Packers Inc.
F.W. Fearman Company Ltd.
Intercontinental Packers Ltd.
J.M. Schneider Inc.
Piller Sausages & Delicatessens Ltd.
Quality Meat Packers Ltd.
Unox, Division of
Thomas J. Lipton Inc.
Vancouver Fancy Meats Co. Ltd.

Poultry and Egg Processors

A.C.A. Co-operative
Association Ltd.
Bexel, Division of Co-op.
Fédérée de Quebec
Canada Packers Inc.
Co-op Dorchester Ltée
Coulombe Quebec Ltée
Export Packers Company Ltd.
La Poulette Grise
Lashbrook Produce Limited
Lilydale Co-op Limited
Lilydale Poultry Sales (Victoria) Ltd.
Lucerne Foods Ltd.
Maple Leaf Mills Limited
Maple Lynn Foods Ltd.
Pembina Poultry Packers Ltd.
P & H Foods Ltd.

Sugar Refineries

Atlantic Sugar Limited
British Columbia Sugar Refining
Company Limited
Lantic Sugar Limited
Redpath Sugars Limited

Wineries

Andre's Wines Ltd.
Inniskillin Wines Inc.
Les Vins La Salle Inc.

General Manufacturing

Chemical, Pharmaceutical and Medical Products

Atkemix Inc.
Glaxo Canada Inc.
Estée Lauder Cosmetics Limited
Ferro Industrial Products Ltd.
Canadian Occidental Petroleum
Limited
Diversey Wyandotte Inc.
Tambrans Canada Inc.

Foundries, Forgings and Heavy Metal Processors

Bibby-Ste-Croix Foundries Ltd.
Canada Forgings Inc.
Canadian Blower/Canada
Pumps Ltd.
Canadian Bronze Company Limited
Canada Ingot Mould Inc.
Canvil Ltd.
Esco Ltd.
Fahramet, Indusmin, Div. of
Falconbridge
Hawker Siddley Canada Inc.
Huron Steel Products Limited
Lake Ontario Steel Company
Limited
Manville Canada Inc.
Metals & Alloys Company Limited
Reynolds Aluminum Company
Limited
Slater Steels, Sorel Forging Division
The Canada Metal Company Limited

Light Manufacturing

Abex Industries Ltd.
Atco Limited
Butler Metal Products Limited
Black and Decker Canada Inc.
Bombardier Inc.
Cooper Tools Ltd.
Dominion Controls Co. Ltd.
Fasco Products, Div. of Indal
Indal Technologies Inc.
Indalloy Ltd., Div. of Indal
Kawneer Company of Canada
Limited
Kodak Canada Inc.
Paddle Valley Products Limited
Snap-On Tools Ltd.
Teledyne Canada Metal Products
Limited
Trane Canada Limited

Rubber Products

Gates Canada Limited
General Tire Ltd.
Michelin Tires (Canada) Ltd.
Trent Rubber Services Limited
Uniroyal-Goodrich Canada Ltd.

Industrial Minerals

Abrasives

Exolon – Esk Co. of Canada Ltd.
General Abrasives – Abrasives
Industries (Canada) Inc.
Norton Advanced Ceramics
of Canada Inc.
Washington Mills Electro
Minerals Corp.

Asbestos

Brinko Mining Ltd., Cassiar Division
JM Asbestos Inc.
Lab Chrysotile (Bell) Inc.
Lab Chrysotile (Lac)
Lab Chrysotile (BC/KB/
Normandie) Inc.

Cement

Inland Cement Limited
Lafarge Canada Inc.
Lake Ontario Cement Limited
(ESSROC Canada Inc.)
North Star Cement Limited
St. Lawrence Cement Inc.
St. Mary's Cement Corporation
Tilbury Cement Limited

Clay Brick and Tile

Briqueterie St. Laurent Ltée
Estevan Brick Company Limited
Hamilton Brick Ltd.
NSP Investments Limited
(Div of NSP Inc.)

Concrete Products

Doughty Concrete Products Ltd.
Downey Building Materials Ltd.
Genstar Materials Limited
Richvale Block & Ready-Mix (Div. of Canada Cement Lafarge Ltd.)
Supercrete (Div. of Canada Cement Lafarge Ltd.)
York Block (Div. of Canada Cement Larfarge Ltd.)

Glass

AFG Glass Inc.
Consumers Packaging Inc.
Fibreglass Canada Inc.
Libbey St. Clair
PPG Canada Inc.

Lime

Havelock Lime Company of Canada Limited
Luzenac Inc.
Reiss Lime Company of Canada Limited
Stelco Steel Company Limited
Summit Lime Works Limited

Miscellaneous Minerals

Falconbridge Ltd.
Indusmin Limited
3M Canada Inc.
Saskatchewan Minerals Ltd.
Steetley Talc Inc.

Refractories

Canadian Refractories Limited
Clayburn Refractories Limited
Continental Refractories Company Limited
General Refractories Co. of Canada Ltd.

Machinery

ACCO Canadian Material Handling A Division of Babcock Industries Canada Inc.
S.A. Armstrong Limited
Ateliers FABRON Inc.
Bevco Conveying Systems
Black Clawson-Kennedy Limited
Boart Canada Inc.
Canadian Blower/Canada Pumps Limited
Continental Conveyor & Machine Works Ltd.
Continuous Mining Systems Limited
Dresser Pump Division, Dresser Canada Inc.
FAG Bearings Ltd.
General Conveyor Co. Ltd.
Gorman-Rupp of Canada Limited
Greey Lightnin
Heath & Sherwood (1964) Limited
Industries USP Inc.
Ingersoll-Rand Canada Inc.
ITT Fluid Products Canada
Jenkins Canada Inc.
H.J. Langen & Sons Limited
MTD Products Ltd.
RMS Machinery Division, Uniroyal Goodrich Canada Inc.
Smart Turner Limited
Ward Ironworks Limited
Webster Air Equipment Division of Curtiss-Wright of Canada Inc.

Mining and Metallurgy

Central Canadian Potash Co. Ltd.
Cominco Ltd.
Denison Mines Inc.
Echo Bay Mines Inc.
Falconbridge Ltd.
Fording Coal Ltd.
Giant Yellowknife Ltd.
Hudson Bay Mining and Smelting Inc.
INCO Ltd.
Iron Ore Company Ltd.
Noranda Ltd.
Placer Dome Inc.
Quebec Cartier Inc.
Rio Algom Ltd.
Syncrude Ltd.
Tech Corporation Ltd.

Petroleum Refining

Consumers' Co-Operative Refineries Limited
Esso Petroleum Canada
Husky Oil Products Company
Petro-Canada Products Inc.
Shell Canada Limited
Suncor Inc.
Syncrude
Texaco Canada Inc.
Turbo Resources Limited
Ultramar Canada Inc.

Plastics

Acriform Engineering Ltd.
American Biltrite (Canada) Ltd.
Atlantic Packaging Products Ltd.
Automotive Industries Ltd. (Donlee)
Beaver Plastics Limited
Bonar Plastics Ltd.
Burman-Castrol Canada Ltd.
Canadian General Tower Ltd.
Celfortec Inc.
Chemacryl Plastics Limited
Coastal Plastics Ltd.
Daymond, Div. of Redpath Industries Ltd.
Duron Plastics Ltd.
F&H Plastics Ltd.
Ferro Industrial Products Ltd.
Formica Canada Inc.
Hayden Manufacturing Co. Ltd.
Horizon Plastics Ltd.
Jet Moulding Compounds Ltd.
Les Plastiques Anchor Ltée.
Les Systemes Thermoplast Inc.
Medallion Plastics Ltd.
Morbern Inc.
Pavaco Plastics Inc.
PCL Packaging Inc.
Plasti-Drain Ltée.
Plasti-Fab Ltd.
Plax Inc.
Polytainers Inc.
Pro-Western Plastics Ltd.
Relmech Manufacturing Ltd.
Rubbermaid Canada Inc.
Roll-O-Sheets Canada Limited
Scepter Manufacturing Co. Ltd.
Scott Polymers Ltd.
Shaw Industries Ltd.
Schlegel Canada Inc.
Tupperware Company Inc.
Union Carbide Performance Plastics Ltd.
Uniplast Industries Ltd.
Vanguard Plastics Ltd.

Pulp and Paper

Abitibi-Price Inc.
Armstrong World Industries Inc.
Atlantic Packaging Products Ltd.
Beaver Wood Fibre Co. Ltd.
Boise Cascade Canada Ltd.
Bowater Mersey Paper Company Limited
Canadian Forest Products Ltd.
Canadian Pacific Forest Products Limited
Cariboo Pulp & Paper Company
Papier Cascades (Cabano) Inc.
Cascades (East Angus) Inc.
Cascades (Jonquière) Inc.
Calgar Pulp Company
Corner Brook Pulp & Paper Ltd.
Crestbrook Forest Industries Ltd.
Daishowa Inc.
Domtar Inc.
Donohue Inc.
Donohue Normick Inc.
Donohue St. Félicien Inc.
E.B. Eddy Forest Products Ltd.
Eurocan Pulp & Paper Co. Ltd.
Fletcher Challenge Canada Limited
J. Ford & Company Ltd.
Fraser Inc.
Gaspesia Pulp and Paper Company Ltd.
Howe Sound Pulp and Paper Limited
Irving Pulp & Paper, Limited
Island Paper Mills Company
James River – Marathon, Ltd.
Kruger Inc.
James Maclaren Industries Inc.
MacMillan Bloedel Limited
Malette Kraft Pulp & Power Inc.
Minas Basin Pulp and Power Company Limited
Miramichi Pulp and Paper Inc.
NBIP Forest Products Inc.
Noranda Forest Recycled Papers
Northwood Pulp and Timber Limited
Paperboard Industries Corporation
Perkins Papers Ltd.
Procter & Gamble Inc.
Quebec and Ontario Paper Company Ltd.
Repap Manitoba Inc.
Rolland Inc.
Rothesay Paper Limited
St. Anne-Nackawic Pulp & Paper Company Ltd.
St. Marys Paper Inc.
Scott Maritimes Limited
Scott Paper Limited
Skeena Cellulose Inc.
F.F. Soucy, Inc.
Sonoco Limited
Spruce Falls Power & Paper Company, Limited
Stone-Consolidated Inc.
Stora Forest Industries Limited
Strathcona Paper Company
Tembec Inc.
Weldwood of Canada Limited
Western Pulp Limited Partnership
Weyerhaeuser Canada Ltd.

Canadian Textile Institute

Albany International Canada Inc.
Barrday Inc.
Barrymore Carpet Company
Bell Tootal Inc.
Bermatex Inc.
Britex Limited
Canada Cordage Inc.
Celanese Canada Inc.
Cleyn & Tinker Inc.
Consoltex Inc.
Coronet Inc., Tapis
Crossley Carpet Mills Ltd.
DeBall Canada Inc., J.L.
Dominion Textile Inc.
Doubletex Inc.
Drytex, Div. of JWI Ltd.
Dura Undercushion Ltd.
Les Tissus Hafner du Canada Ltée
Harding Carpets
Harvey Woods Limited
Huyck Canada Limited
Interface Flooring Systems Canada
La Gran Canada Inc.
Marimac Inc.
Newlands Inc.
Niagara Lockport Quebec Industries Inc.
Nova Scotia Textiles Ltd.
Ozite Canada (1081) Inc.
Patons & Baldwins Canada Inc.
Peeters Carpets Ltd.
Rayonese Textile Inc.
Rubyco (1987) Inc.
Rumpel Felt Co. Ltd.
Sauquoit Industries Ltd.
Scotwell International Inc.
Spinrite Yarns & Dyers Ltd.
Stewart Group Ltd.
Les Tapis Peerless Ltée. (Plant No. 3)
Tapis Venture Ltée.
Textiles Dionne Inc.
Tricots Canada U.S. Inc.
Tricots Duval & Raymond Knitting Ltée, Les
Union Felt Products Ont. Ltd.
Vagden Mills Ltd.
West Coast Woollen Mills (1986) Ltd.

Transportation (Mfg.)

Aerospace Industries Association of Canada

Aircraft Appliances and Equipment Limited
Airtech Canada
Allied Signal Aerospace Canada, Bendix Avelex Inc.
Allied Signal Aerospace Canada, Garrett Canada
BOEING CANADA, de Havilland Division
Bombardier Inc., Canadair Division
CAE Electronique Ltée.
Canadian Marconi Company
Chicopee Manufacturing Limited
Computing Devices Company
Ebco Industries Ltd.
Field Aviation East Ltd.
H.I. Thompson Co.
Haley Industries Ltd.
Indal Technologies Inc.
Litton Systems Canada Limited
Lucas Aerospace Inc., Control Systems Division
McDonnell Douglas Canada Ltd.
Oerlikon Aerospace
Raytheon Canada Limited
Rockwell International of Canada Ltd.
Rolls-Royce (Canada) Limitée
Spar Aerospace Limited
Tube-Fab Ltd.
UDT Industries Inc.
Unisys Canada Inc.
Walbar Canada Inc.

Automotive Parts Manufacturers' Association

A.W.K. Industrial Coating

Accurcast Limited
Algoods, Division of Alcan Aluminum Limited
Amcan Castings Limited
B & W Heat Treating (1975) Limited
A. Berger Precision Ltd.
Blackstone Industrial Products Limited
Budd Canada Inc.
Butler Metal Products, A Division of BMG Canada Limited
Canada Forgings Inc.
Cochrane Tool & Design Limited
Collins & Aikman, A Division of WCA Canada Inc.
Degussa Canada Ltd.
Dominion Controls Company
Epton Industries Inc.
FAG Bearings Ltd.
Fahramet Steel Castings
GE Plastics Canada Ltd.
Goodyear Canada Inc.
Hayes-Dana Inc.
Hyundai Auto Canada Inc.
ICM/Krebsoge
Jet Moulding Compounds Limited
Johnson Controls Inc.
Kelsey-Hayes Canada Limited
Lagran Canada Inc.
MTD Products Limited
Nichirin Inc.
PPG Canada Inc., Duplate Division
Quality Safety Systems Company
Reynolds Aluminum Company of Canada Ltd.
Rockwell International Suspension Systems Company
Sheller-Globe
Siemens-Bendix Automotive Electronics Limited
Sinteris Inc.
Slater Steels Corporation
Standard Tube Canada Inc.
Stemco Canada
Tesma International Inc.
Thomson (Canada) Rivet Co. Limited
Thyssen Marathon Canada
Torrington, Div. Ingersoll-Rand Canada Inc.
TRW Canada
Westhead Industries

Canadian Marine Industries Association

International Paints (Canada) Limited
Marystown Shipyard Ltd.
MIL Davie Inc.
MIL Tracy, MIL Group
Port Arthur Shipbuilding
St. John Shipbuilding Limited
Securiplex
Vancouver Shipyards
Versatile Pacific Shipyards Inc.

Canadian Truck and Trailer Manufacturers' Association

Fruehauf Canada, A Division of Gemala Industries Ltd.

Allied Boating Association of Canada

ITT Fluid Products Canada

Motor Vehicle Manufacturers' Association

Chrysler Canada Ltd.
Ford Motor Company of Canada Limited
General Motors of Canada Limited
Navistar International Corporation Canada
Volvo Canada Ltd.

Wood Products (Western)

Atco Lumber Ltd.
Canadian Forest Products Ltd.
Canadian Pacific Forest Products
Crestbrook Forest Industries Ltd.
Doman Forest Products Limited
Evans Products Co. Ltd.
Federated Co-Operatives Ltd.
Fletcher Challenge Canada Limited
MacMillan Bloedel Ltd.
Nechako Lumber Co. Ltd.
Northwood Pulp & Timber Ltd.
The Pas Lumber Company Ltd.
Quesnel Forest Products
Riverside Forest Products Ltd.
Rustad Bros. & Co. Ltd.
Weldwood of Canada Limited
West Fraser Mills Ltd.
Zeidler Forest Industries Ltd.

Appendix A

Reporting Methodology

The objective of the CIPEC monitoring system is to track as closely as possible the actual changes in production energy intensity. Performance monitoring procedures and accounting methodology used by the task forces followed a prescribed aggregating method established by CIPEC in 1975.

The basis of the CIPEC method is to compare energy consumption to physical units of production, where possible. This is done by determining the difference in current year consumption to the energy that would have been used in a base year (at the same level of production) before any efficiency improvements had taken effect.

The quantity of energy savings claimed is calculated as the difference between the total current year energy consumption and the base year equivalent energy consumption. Each year the base year equivalent energy consumption is determined by aggregating the results of each participating company. This method of determining changes in energy-intensities thus incorporates the total effects of changes in production-mix, production volumes, technologies, and energy conservation activities.

Similarly, energy cost savings is the difference between what would have been spent on energy (if there had been no efficiency improvement) and the current energy expense. The figure fluctuates because of the voluntary nature of participation in the program; estimates of energy savings depend on the quantity of energy reported by the CIPEC participating companies and total efficiency improvement in that particular year.

Feedstocks used in the chemical and petroleum refining industries are not included in the task force or CIPEC accounting system since conservation of these commodities is not an issue. However, process improvements which register as site throughput reductions are regarded as conservation of energy. In the ferrous metal industry, the metallurgical coal that is used to make coke for steel manufacture is treated as a primary fuel input.

Since reporting began, it has been necessary to apply minor adjustments to the consumption numbers to normalize the impact of fluctuations in weather, added energy consumption from imposed environmental equipment and periodic changes in raw material quality. These corrections are done at the individual company level which often report both gross and net efficiencies. This practice will be continued to allow participants to make future adjustments where necessary.

After more than a decade of CIPEC monitoring most task forces updated individual reference years to 1985 to recognize the many fundamental changes that have occurred since the beginning of the program. Reporting of future performances will carry forth the past achievements, however, to retain the long term trends in performance.

Appendix B

Prefix	Multiple	Symbol
kilo	10^3	k
mega	10^6	M
giga	10^9	G
tera	10^{12}	T
peta	10^{15}	P
exa	10^{18}	E

Energy	Metric	Imperial
Electricity – net	3.6 MJ/kWh	3,414 BTU/kWh
– gross	10.551 MJ/kWh	10,000 BTU/kWh
Natural Gas	37.2 MJ/m^3	1.0 x 10^6 BTU/MCF
Propane	26.6 MJ/litre	0.1145 x 10^6 BTU/IG
Crude Oil (#6)	38.5 MJ/litre	5.8 x 10^6 BTU/bbl
Distillate Oil(#2)	39.0 MJ/litre	0.168 x 10^6 BTU/IG
Residual Oil (#5)	42.3 MJ/litre	0.182 x 10^6 BTU/IG
Coal – Bituminous	32.1 GJ/tonne	27.6 x 10^6 BTU/ton
– Subbituminous	22.1 GJ/tonne	19.0 x 10^6 BTU/ton
– Metallurgical	29.0 GJ/tonne	25.0 x 10^6 BTU/ton
Coke – Petroleum (Raw)	23.3 GJ/tonne	20.0 x 10^6 BTU/ton
Gasoline	36.2 MJ/litre	0.156 x 10^6 BTU/IG
Diesel Fuel	39.9 MJ/litre	0.172 x 10^6 BTU/IG
Kerosene	38.8 MJ/litre	0.167 x 10^6 BTU/IG
Liquid Propane Gas (LPG)	27.1 MJ/litre	0.117 x 10^6 BTU/IG

To Convert from	to	Multiply by
Cubic Feet	Cubic Metres	0.028
Cubic Feet	Gallons (Imperial)	6.229
Cubic Feet	Litres	28.316
Barrel (Oil)	Cubic Metres	0.159
Barrel (Oil)	Gallons (Imperial)	34.973
Gallon (Imperial)	Litres	4.546
Gallon (U.S.)	Gallons (Imperial)	0.8327
Short ton	Pounds	2000
Short ton	Tonnes	0.9072
Tonne	Short tons	1.102
Long ton	Pounds	2240
Long ton	Tonnes	1.016
Kilogram	Pounds	2.205
BTU	Joules	1055.1
Kilojoule	BTU	0.948
Gigajoule	Barrels Oil Equiv.	0.164

The information, perspectives and data reported herein are solely the responsibility of the Canadian Industry Program for Energy Conservation Council and the reporting task forces.

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Energy, Mines and Resources Canada

Énergie, Mines et Ressources Canada

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